

AN
ENQUIRY

INTO THE
CONTENTS, VIRTUES,
and USES,

OF THE
Scarborough SPAW-WATERS:
WITH

The Method of examining any other
MINERAL-WATER.

By *PETER SHAW*, Physician at *Scarborough*.



LONDON:

Printed for the AUTHOR, and are to be Sold by
FLETCHER GYLES in *Holborn*, and C. WARD
and R. CHANDLER, at the *Ship* between the
two Temple Gates in *Fleet-street*, and at their
Shop in *Scarborough*. MDCCXXXIV.

ENQUIRY

INTO THE

CONTENTS, VIRTUES

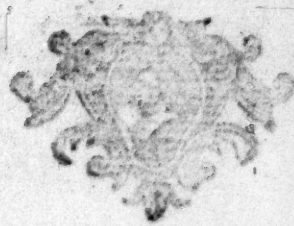
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By PETER SHAW, Physician at Scarborough.



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Printed for the Author, and are to be sold by
Francis & Taylor, in Pall-mall, and C. Ward
and R. Chandler, at the Ship between the
two Temple Gates in Fleet-street, and at their
Shop in Scarborough. MDCCLXXIV.

TO

Dr. MEAD.

SIR,

AS the *Scarborough* Spaw-Waters are, in great measure, obliged to You for the present Character they bear; it is but natural that an Enquiry into their Contents, Virtues, and Uses, shou'd be address'd to a Person so well acquainted with the Subject.

These Waters, fraught with Virtues formerly known to few, and healing chiefly the Sick of inferior Rank, are, at

A 2

length,

DEDICATION.

length, by your Experience, and a subsequent, just and generous Recommendation of them, introduced into better Company; and now cheer the Spirits, and brace the Nerves, of Peers as well as Commoners.

This, Sir, is one of the many Benefits which You have conferr'd upon Mankind: and as the present Enquiry may help to shew how signal it is; I persuade myself, that neither You, nor the Publick, will be displeased with the Attempt of,

SIR,

Your most obliged Humble Servant,

PETER SHAW.

THE
P R E F A C E.

IT is, perhaps, a much more difficult Thing than Men usually imagine, to give a just Account of the Contents, Virtues and Uses of any Mineral Water; especially when those who attempt it, or those who judge about it, have not been versed in the making of philosophical, and chemical Experiments.

Hence it may, probably, appear strange to many, that the Queries proposed in the present Enquiry shou'd be so numerous, the Apparatus so large, and the Method aim'd at so rigorous: tho' all this will easily be excused by those who know what Errors have been committed, in the like Attempts, for want of a competent Number of leading Questions, exact Instruments, and a suitable Habit of using them.

But the present Undertaking, it is hoped, will not be found to expose the Failures of others; or to set itself up in Competition with any Enquiry of the same kind. This wou'd be to defeat the End proposed; which is no other than, with proper Deference, to point out a Way of bringing physical Enquiries to physical Certainty; and, without interfering with any one, to try if, by using the Art of Induction (an Art hitherto very little known, or practised) more of the Nature of Mineral Waters may not be discover'd, than has formerly appear'd.

This

The P R E F A C E.

This Attempt may, indeed, be censured as aspiring to great Things; but then they are Things of a philosophical Nature, and of general Use; where some degree of Aspiring has usually been thought laudable.

But there is hitherto no Room for Exultation; as the Foundations of the Design are not yet well laid: and so much Pains will be required to finish it, that the Labourers in it may reasonably expect to escape uncensured. To say the Truth, this is no Work for a private Hand; and unless it meets with Assistance and Encouragement, is never likely to be finished at all.

The whole Design is no less than the procuring just and real Histories of the Mineral Waters of England; according to the Intimation of a Plan lately laid down for that purpose. And tho' some Materials for the Work may be collected from several modern Writers of natural History; and, particularly, from a late laborious Account of the Mineral Waters of Derbyshire, Lincolnshire, and Yorkshire, by Dr. Short; yet, when the Matter comes to be thoroughly consider'd, perhaps it will be found necessary to extend the whole Enquiry, verify the present Sets of Experiments, make abundance of new ones, and work all up into sound and methodical Histories. And here is Employment for a number of Hands.*

The following Piece, tho' it undertakes to enquire into but one Mineral Water; yet presumes to offer Rules and Directions, for enquiring into all others; as nothing appears to have been more wanting, in this Affair, than an adequate Method of Enquiry,

* See the Appendix to Dr. Hoffman's new Experiments and Observations upon Mineral Waters.

capable of directing Experiments, verifying Particulars, bringing them to Order, and manifesting the Result. But how far this Point is carried, or how far it falls short, must be left to the Judgment of experimental Philosophers.

The direct Enquiry itself into the Scarborough Spaw-Water, is here carried but a little Way, or barely begun; if Opportunity serves, it is proposed to carry it farther; and to endeavour the raising a just History thereof: but this must be the Business of several Years; and if ever compleated, will, possibly, be the first Example, that has been set, of a full, inductive History of any Mineral Water.

But as the Sketch, at present, is so imperfect, an Objection may easily arise against the hasty publishing of it, in a Form so disadvantageous both for the Reader and Author; on a Supposition that it might have been better for both to have finish'd the Design, by degrees; and, at length, to have given the Result, in a direct and concise manner; without entering into a Detail of the Apparatus; and shewing the several Steps of the Procedure; as a Builder exhibits a House after the Lumber and Scaffolding are removed.

To this Objection the Author replies, that, however it may fare with himself, he conceives it much more advantageous for the Publick, to shew the Ground-Work of the Art of Induction, than to dress up a few Discoveries in the most agreeable manner that cou'd be invented; as this Art is of infinite Use; or no less than a sure Method of making all the Discoveries in Nature that Mankind can reasonably hope for. And tho' the Author pretends not to be the Inventor, or any tolerable Master, of this Art; yet he judges that it may best be taught by shewing the first Rudiments of an Enquiry conducted accord-

ing

ing to its Rules: and, therefore, wou'd chuse, for the present, to publish the Out-lines of a History, rather than a finish'd Piece upon the Subject; tho' he were, what he is not, able to give one: thus endeavouring to follow the Example of an Architect, who, designing not so much to raise a particular Structure, as to teach the whole Art of Building, thinks proper to deliver the Ways even of burning the Brick, and mixing the Mortar.

And this open Procedure is directed by the Art of Induction; which forbids the Use of sophistical Ornaments and Concealments; how much soever they might be made to serve the By-Ends of an Author, or amuse the Reader.

ERRATA.

PAG. 26, l. 27, and p. 27, l. 2, for *unctious* r. *unctuous*; p. 43, l. 4, for *first* r. *last*; p. 47, l. 26, after *course*, insert *with*; p. 56, l. 21, for *and* r. *or*; p. 62, l. 30, after *particular* insert *Nature*; p. 63, l. 19, for *hot* r. *hit*; p. 66, l. 9, for *Substance* r. *Substances*; p. 73, l. 15, after *degree* insert *of Heat*; p. 74 l. 22-24, read *thus*, if other, the like Glasses, and Bladders, be also filled, or half filled, with the same Water (after having stood in the open Air) and secured, &c. p. 78, l. 22, for *and* r. *are*; p. 95, l. 15, after *Part*, insert *and*; ib. l. 27, for *Passages* r. *passes*; p. 98, l. 16, after *time*, insert *giving*; p. 103, l. 24, *dele* the second *this*; p. 107, l. 12, before *earthy* insert *the*; p. 110, l. 21, after *shall*, insert *see*; ib. 28, and p. 126, l. penult. for *neut'al* r. *natural*; p. 135, l. 13, for *Edulurants*, read *Eduleorants*; p. 149, l. 27, after *produce*, insert *it*; p. 155, l. 29, before *Powder*, insert *the*.

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AN ENQUIRY

INTO
The CONTENTS, VIRTUES, and USES
OF THE
Scarborough SPAW-WATERS, &c.

PART I. *The ORDER of ENQUIRY.*

SECT. I. *Of the LAWS of ENQUIRY.*

I. **T**HE Disputes that have happened about the Examination of these Waters^a, make it necessary to settle the Laws of the present Enquiry, before it be gone upon: otherwise much Time, and Pains, might be fruitlessly employ'd; and the Subject, after all, remain dark and confused.

^a See Dr. Wittie, Simpson, Tonstal, Lister, &c. upon the *Scarborough Spaw-Waters.*

Conditions, or Laws of the Enquiry.

LAW I.

2. As the present Enquiry is physical^b, or concerned with material Objects; let it proceed upon physical Observations, Experiments, and the Art of Reasoning: these being the Instruments, or Means, of promoting Natural Knowledge; and, in particular, of discovering the Contents, Virtues and Uses of Mineral Waters.

EXPLANATION.

3. The Thing here intended being an *Enquiry* into the Contents, Virtues and Uses of a certain Water; this Enquiry must, of necessity, be carried on by the Assistance of physical Observations and Experiments: For, it is not in the Power of Imagination, Conjecture, abstract Reasoning, or any Thing else, without Observation, and Experiment, to assign the Contents, Virtues, and Uses of a Mineral Water. And the Art of Reasoning should here be employ'd only to suggest, and direct, the proper Experiments, and Observations, to be made; compare them together; draw out the Result; and direct a Renewal, or farther Prosecution, of the Enquiry; till, at length, it may end in a perfect physical History of the

^b By the Word *physical* is here meant, not medicinal; but what is usually express'd by the Words *natural* and *experimental*; tho' *physical* implies still more; and includes whatever relates to a Subject, consider'd as Matter, or a material Object. Thus the physical History of any Mineral Water, is the Natural, Experimental, Medicinal, Oeconomical, or Practical and Theoretical History of that Water.

Sub-

Sect. I. *Laws of ENQUIRY.*

Subject. Whence we derive a fundamental Rule, directing us, in the present Undertaking, (1) what to avoid ; (2) what to pursue ; and (3) what Method to take ; as may appear below.

LAW II.

4. Let nothing be admitted into this Enquiry besides (1) Matters of Fact, or History, belonging to the Subject ; (2) Matters of Observation regarding the same ; (3) Suitable Experiments ; and (4) Matter of Reasoning, in direct relation to the preceding Particulars : omitting whatever is foreign to the Design of a physical Enquiry ; whether Matters of Learning, or Quotations ; Matters of Dispute, or mere Speculation : For we are not hereto diviate, confute, conjecture, or suppose ; but to find out the Facts and Laws of Nature.

EXPLANATION.

5. The Reason for admitting of nothing, in this Enquiry, besides Fact, Observation, Experiment, and the Use of the rational Faculty, is that these are sufficient to form a compleat physical History of the Subject ; which is the End of a physical Enquiry : and again, because whatever is of a different kind, draws the Mind off, or diverts the Enquiry ; and swells the Discourse, without adding to its real Merit, or Use.

LAW III.

6. Let the Facts, Experiments, and Observations employ'd be not wholly of the vulgar, and obvious, kind ; but let others be sought after, and made, with Choice and Design ; so as to en-

Laws of ENQUIRY. Part I.

ter the Nature of the Subject; and either bring Light, and Information, to the Mind, or Advantage to the Enquiry; with a View to its ending in an exact and full History.

EXPLANATION.

7. Common Facts, Observations, and Experiments seldom go far in discovering the internal Nature of a physical Subject; which usually lies deep, and requires to be searched into with Application and Address, before it will open, or manifest itself: and in this Light, Observations, and Experiments, properly made and tried, may be consider'd as the Tortures of Art, that bring Nature to a Confession. And thus, when a competent number of select Facts, Observations, and Experiments, are procured, ranged, and compared together, and their Consequences deduced, in natural Order; this will, by degrees, and as it were spontaneously, give us the physical History of the Subject.

LAW IV.

8. Let the Method observed be the direct Method of Enquiry, or Investigation; which proceeds from one Particular to another; so as, at length, to come at more general, or comprehensive, Truths; in the Way of a physical Induction^c: whence the Sum, or Result, of the Enquiry may, at last, appear in a few general Corollaries, or Deductions; which, in a con-

^c By *physical Induction* is meant the Art of pursuing a Subject thro' all its Heads, till the physical History thereof be obtained; and the natural Consequences deduced. See this more fully explained hereafter under *Se^{ct}. IV.* §. 3 — 7.

tracted View, will exhibit the principal Fruits of the Enquiry; and, so far as that is carried, give both the Theory and Practice relating to the Subject.

EXPLANATION.

9. The Particulars directed by this Law are, (1) that certain Heads, or Articles, of Enquiry, be first proposed, as Questions to be solved; with Directions for doing it: (2) that the several Ways of Trial, or the Experiments designed to assist the Enquiry, be previously explained, and their validity considered: (3) that the necessary Cautions be all along given, and the Circumstances of the Experiments, and Observations, noted; for the better enabling others, by a Repetition, to falsify, verify, or improve them: and (4) that Care be taken to render the whole Procedure intelligible; by using a plain Style, a clear Method, and an Exactness in relating of Facts, Experiments and Observations; so that every one may judge how far the Enquiry is just, how far defective, or how it may be advanced, and perfected: these Particulars being necessary in a physical Induction.

S E C T. II.

Of the Heads, or Articles of Enquiry.

1. IT is of considerable Use, in the beginning of a natural Enquiry, to have a comprehensive Set of Heads, or leading Questions, previously drawn up, in some tolerable Order; so as to point out the principal Particulars to be enquired after; lead into the Method of prosecuting

the Enquiry; and direct the several Steps to be taken in it: For the whole Business being thus divided into manageable Parts, each of them may be separately wrought upon, to advantage; whilst, by this Contrivance, the Mind is less distracted; and a prepared, or digested, Matter more readily furnished for a History of the Subject: tho' this Matter, these Heads, and the Method itself, must necessarily, at first, be rough and imperfect; so as to require alteration, and amendment, when the History shall come to be wrote.

2. Every Mineral Water may deserve to be enquired after in three general States; viz. (1) in its Rise, or Passage under Ground, and Receptacle; (2) in a State of Separation from the Spring, Course or Well; and as contain'd in Vessels, or Glasses: and (3) as drank by Men, or taken into the Body. These three States must be, therefore, regarded in our Articles of Enquiry.

I.

*The Waters consider'd in their Rise,
Course, and Receptacle.*

Article 1. What is the Situation of the Well, or Receptacle?

3. This Question chiefly regards the Situation of the Well with respect to the Course of the Sun, the blowing of the Winds, and the nature and form of the circumjacent Country: as these Particulars are necessary to be enquired into, on several Accounts. Thus, for example, if a Water, abounding with a volatile mineral Substance, or Spirit, should be strongly beat upon, in its Receptacle, by the Rays of the Sun, or by the Winds;

Winds; these might carry off some part of the Spirit, and render the Water less brisk, or active. So again, if the Well should lye low, or near the Sea; this might subject it to be overflowed by the Tides; or to have its Water weaken'd by Rain, or other common Waters, falling into it, from the higher Grounds, &c.

What is the Rise, and Course, of the Water to the Article 2. Well?

4. This may sometimes be difficult, or impracticable, to trace, on account of Mountains, Lakes, or other intervening Obstacles: tho' the Thing itself is of Consequence; as it might lay open the Beds, and discover the Mineral Matters, thro' which the Water runs, or is strained: for it may be suspected, that Mineral Waters are no more than common Water impregnated with certain Mineral Substances, capable of dissolving, or lodging, therein. And under this Head it might be proper to enquire into the physical Origin, and Cause, or Causes, of Springs, in general; since considerable Light might thence be derived to the present Enquiry.

What Minerals lie in the contiguous and circumja-cent Parts? Article 3.

5. This Question has an affinity with the foregoing; but carries the View farther; and directs an Enquiry to be made near the Confines of the Water-Course, and the Well-Head; in order to discover the Mineral Matters that are lodged, or bedded, there; particularly the softer or more volatile kinds, and such as, upon trial, are found to communicate any new, or uncommon, Property to Water: because such Matters may affect the Mineral Water, by their Effluvia,

or Exhalations^d, tho' the Matters themselves lie at some distance from the Course of the Water.

Article 4. What Substance, or Substances, are left, or deposited, by the Water, on the Sides, or Bottom, of the Channel, or Receptacle?

6. These Substances, whatever they are, being compared with the softer, or more soluble, Mineral Matters, found in the Course of the Spring, or adjacent to it, may help to discover the Contents of the Water. Thus, for instance, if a soft, soluble, Oker be found in, or near, the Course of the Spring; and a soft ochry Substance be found deposited on the Sides, the Bottom, or Confines of the Channel, or Receptacle; there will be a Presumption that the Water, in the Receptacle, is impregnated with the lighter parts of such Oker: tho' the Confirmation thereof must be had from particular Experiments, capable of manifesting that the Water actually contains such ochry Particles^e.

Article 5. Are any visible Fumes, Exhalations, Exudations, Efflorescences^f, or saline Concretions, to be found near the Course of the Water?

7. If any thing of this kind appears, it should be carefully examined into; because the Waters

^d By *Effluvia* are here meant, the fine, or almost insensible, Particles, which, in a dry form, fly off from Bodies; and by *Exhalations*, those that fly off from them in a moist one.

^e See this Matter farther explain'd hereafter, under *Seft. IV.*

^f By *Exudations* are here understood any mineral Juices that appear to sweat, or ouze, out of mineral Matters; or such mineral Juices as, by standing, or being exposed to the Sun, or open Air, harden, crystallize, or concrete, into Salts, or Vitriols. And by *Efflorescences* are meant the appearance of any light, mealy, or saline Matter, covering a mineral Substance, in the form of Snow, Down, Feathers, or Flowers.

may

SECT. II. *Articles of ENQUIRY*

may hence be easily impregnated ; as we see by the Fumes of burning Brimstone, and the Exudations, or Efflorescences, of those called Marcasites, or Pyrites ; * which sweat out a vitriolick Juice, or Salt, in the open Air : and most saline Concretions readily dissolve in Water ; so as by Rain, or otherwise, to be easily washed down, and carried into the Course, or Receptacle, of a Spring.

Can any part of the Water, in its Course, be discover'd to be of the nature of common Water ; and to begin to receive its mineral Properties at a certain Place ; either by passing over certain Beds of mineral Matters, or by receiving any mineral Fumes, or Juices, before it comes to the Receptacle ? Article 6.

8. This Question carries on the View of the second, and third ; and may afford great Light in the Enquiry : or, possibly, lead to the Discovery of *Artificial Methods of preparing Mineral Waters.*

Does the Water come to the Receptacle in one Stream, or more ? If in more, is there any difference betwixt them ; or do they any where mix before they arrive at the Well ? Article 7.

9. It seems possible, where there are several Streams, that one may be richer, or more im-

* *Marcasites, or Pyrites*, are a certain kind of stony Matters, whereof Vitriol, or common Copperas, is usually made. When broke they appear shining and metallick ; but burn blue in the Fire ; and afford, upon fusion, only a small proportion of Metal ; or seldom more than a *Regulus*, or imperfect metallick Substance. They are plentifully found in *England* ; and may deserve to have their History, traced ; particularly with a View to mineral Waters : for there are some Reasons to suspect that these are often the Cause of hot Springs ; as they conceive heat with moisture ; and may, perhaps, yield what may be called a mineral Spirit.

pregnated

pregnated with mineral Virtue, than another ; so that a Receptacle being made for the strongest, this alone may be preserved, unmixed with the weaker ; and thus the Water be render'd more medicinal.

Article 8. Is there only one Receptacle, or more? If more, what is their distance, and difference, from each other? Or, are they supplied by the same Streams, as to number, or quantity and quality of the Water; or do they communicate with each other?

10. If any difference be found in the Contents, or Virtues, of the Waters of the different Receptacles, Physicians may thence direct the use of any one preferably to the rest ; according to the difference of Diseases, and Constitutions.

Article 9. What are the Materials, and Dimensions, of the Receptacle, or Receptacles; how often are they filled in 24 hours; or what is the quantity of Water afforded by the Spring in a given Time?

11. This Article tends to shew whether the Matter of the Bason be suited to the nature of the Water ; by what number of Drinkers the Spring may be frequented ; how often the Water is renew'd ; how far it is capable of answering the Demands there may be for it, at home and abroad ; and whether the Receptacle is duly proportion'd to the Spring, for preserving the Water, and affording it fresh and perfect.

Article 10. What other Springs, or Waters, are found near the Place of the Sparw; and what are their Contents, Virtues, and Uses?

12. Tho' this Article has but a remote Relation to the Subject ; yet it claims admittance into the Enquiry ; as it may shew a Difference be-

I. Sect. II. *Articles of ENQUIRY.* 11

betwixt the adjacent Waters; discover some that may be properly mixed, for particular purposes, with those of the Spaw, and used in the making of Experiments.

Is there any Scum, or other light Matter, found upon the Surface of the Water; and if there be, what is the Nature and Properties thereof? Article 11.

13. This Article may have its use in discovering the Contents, and Virtues, of the Water; as such a Scum, or light floating Matter, may contain certain Parts of the Water, or impregnating mineral Matters, condensed, or brought into a small Compass.

How long has the Water been discover'd? How has it been preserv'd? What Alterations has it undergone, with regard to the Accidents of Time, the Weather, Ruins, or other Contingencies? Article 12.

14. This Article may procure Light, not only to the present Enquiry; but likewise to others of the same kind.

What are the sensible Qualities of the Water in its Receptacle; or what are its degrees of Coldness, Clearness, Quickness to the Smell, Briskness to the Taste, and Specifick Gravity^h? In particular, is the Water brisker, or more spirituous, when taken from near the Bottom, than when taken near the upper Surface of the Well? Article 13.

^h By Specifick Gravity is meant the relative weight of a Body, compared with that of another, or of common Water. Thus to determine the Specifick Gravity of a mineral Water, is to determine how much it is lighter, or heavier, in the same bulk, or measure, than common Water. A Pint of common Water weighs nearly a Pound: but a Pint of certain Mineral Waters weighs considerably less than a Pound: that is, such Mineral Waters are so much specifically lighter than common Water.

15. The

15. The determination of these Particulars may shew the Advantages, or Disadvantages, of keeping the Well open, and taking the Water up by the Hand; or keeping the Well close, and raising the Water by means of a Pump.

16. And these are the principal Heads that occur, with relation to the Waters in their Rise, Course, and Receptacle, upon the first View of the Subject.

II.

The Waters consider'd in a State of Separation from their Spring, Course, or Receptacle.

Article 14. What are the Appearances, and sensible Qualities, of the Waters upon being fresh taken up, in a clean Glass, from the Receptacle; and directly examin'd, by the Senses, at the Well-Head? Do they sparkle, or bubble in the Glass? What is their Smell, Taste, Colour, Coldness, Clearness, and Specifick Gravity?

17. The best way of prosecuting a physical Enquiry seems to be by beginning with the Examination of the sensible Qualities of the Subject; or, at first, using the direct Testimony of the Senses; and carrying that as far as it will go: but afterwards contriving, and using, particular Helps for the Senses; so as to bring those things before them, which wou'd not otherwise appear: whereby a much more intimate, and physical, knowledge of the Subject is procurable.

Article 15. How do the sensible Qualities of the Water alter by standing, at the Well-Head, in the same Glass, in the open Air, for some hours, or days?

18. Whilst the Water remains in its Spring, Channel, or Receptacle, it probably receives a greater

greater degree of Motion, than when contain'd in a Glass; and may here, therefore, have a greater opportunity of letting its grosser Parts fall to the bottom; and of suffering what may be called a natural Analysis, or Separation: whence it may be expected that some of the heavier Parts will now subside, and some of the lighter fly off, or quit the body of the Water; leaving it less brisk, or spirituous.

What Alterations does the Water undergo in length of Time? will it actually ferment, or putrefy, by long standing, unsecured, in the open Air; or when well sealed down in Glass-Bottles; and this either with the Motion of Carriage, or without?

19. Care shou'd be taken to determine whether the Water will, any way, undergo a true Putrefaction, or Fermentation; so as to afford different Phænomena, manifest different Contents, or produce different Effects, from those it is found to have in its sound, or natural state.

What are the best Methods, hitherto known, and used, of taking up, preserving, and securing the Water for Transportation, and Carriage? And if these Methods are defective, how may they be improved?

20. Under this Article will come to be consider'd the Ways of preparing, filling, corking, cementing, and packing of the Bottles; with the proper Seasons of the Year, and hours of the Day, or Night, fittest for the purpose.

What Effects have the greatest Degrees of the Summer's Heat, and the Winter's Cold, upon the Water?

21. This

21. This Article tends to begin the Analysis of the Water ; as it may shew what Parts are exhalable by Heat, or separable by Cold.

Article 19. *What Phenomena, or Alterations, does the Water manifest upon adding a suitable variety of Things to it ; with a view to discover its Contents ?*

22. This Article is of large extent ; and requires to be prosecuted with diligence, and exactness. But the Foundation of the Procedure shou'd be laid down, and the Validity of the Experiments shewn, before any Conclusions are drawn from themⁱ.

Article 20. *What Substances are the Waters resolvable into, by an exact chemical Analysis ?*

23. This Article, duly prosecuted, may prove eminently serviceable, or perhaps satisfactory, in the present Enquiry ; as tending to shew both the volatile and fix'd Contents of the Water, in different Seasons ; with their respective Proportions, Virtues, and Uses^k.

Article 21. *Wherein does this Water differ from other Mineral Waters, of kin thereto ; suppose those of the German-Spaw, Pyrmont, Tunbridge, &c.*

24. This Article, relating to the Comparative History of the Water, shou'd be prosecuted till some remarkable, and essential Difference, or Correspondence, appears.

Article 22. *Can the Water be imitated by Art, or recomposed from its own-separated Parts ?*

25. The Answer here will have a great dependance upon the justness, or exactness, of the

ⁱ See hereafter, Sect. IV.

^k See below, Sect. IV, V.

Sect. II. *Articles of ENQUIRY.*

15

Analysis, and the Manner wherein the Imitation, or Recomposition, is attempted; which must be directed by the Light gain'd from the Enquiry.

III.

The Waters consider'd as a Medicine.

What are likely to be the medicinal Effects of the Article 23:

Water, taken into the Body; judging from the Information gain'd by prosecuting the preceding Articles of Enquiry?

26. The Answer, in this Case, will be adequate, or inadequate, according to the Certainty, or Uncertainty, of the Discovery made of the Contents of the Water: whence the present, compared with the following Article, may shew how far that Part of the Enquiry has been just, or its Discoveries valid.

What are the medicinal Virtues of the Water, found Article 24.

upon competent Experience, or Trial, by drinking them? And for the Cure, or Relief, of what Distempers are they adapted, or found serviceable?

27. Under this Article it may be proper to enquire whether the Water has any specifick Virtue, or Power of curing a certain Distemper, or Distempers, in a more easy, expeditious, or effectual manner, than any other known Water, or Remedy.

What are the physical Effects produced in the Body, Article 25.

by drinking the Waters, for a competent Time, in a competent Quantity; so as clearly to manifest their Effects?

28. Thus, in particular, it may be enquired how they affect, or alter, the Blood, the Pulse, the

the Head, the Tongue, the Urine, &c. of the Drinkers.

Article 26. May the Use of the Water be extended to the Cure, or Relief, of any other Distempers, besides those it is drank for at present?

29. The Answer must here be derived from a knowledge of the Contents of the Water; its approved Virtues; and from its farther application, in new Cases.

Article 27. What Changes have hitherto happen'd in the Method of drinking the Water; and with what Advantages, or Disadvantages?

Article 28. Are any Errors committed in the present Method of drinking the Water? And, if there are, how may those Errors be corrected?

Article 29. Shou'd not different Methods of drinking the Water be introduced, suitable to the Nature of particular Distempers, Constitutions, and Ways of Living?

Article 30. What are the best Ways, hitherto known, of promoting the Operation of the Waters, suitably to the Distemper and Constitution? And shou'd they, in all Cases, be taken as an Evacuant, or not, sometimes, rather as an Alterant?

Article 31. What are the best Methods of preparing the Body; so as, in the shortest Time, to receive the full Benefit of the Waters; without hazard, or danger?

Article 32. Are any Correctives, or additional Remedies, proper to be used along with the Waters?

Article 33. How long shou'd the Waters be drank in different Cases; in what Quantities; and at what Intervals?

tervals ? Or, shou'd Medicines be interposed during the Course ?

What is the best and safest Dose of the Water, Article 34. to begin with ; how shou'd the Dose be increased ; and how long shou'd the Course be continued, with respect to the Disease, Constitution, Way of Living, Alteration of the Weather, or Season of the Year ?

Shou'd any Medicines be taken after the Course is Article 35. finished ?

What are the properest Seasons of the Year for drinking Article 36. the Waters ?

Is it proper to repeat the Course, for several Years Article 37. successively, in some Cases ; or to intermit it, for a Year or two, and afterwards repeat it ?

What Regimen, as to Diet, Exercise, &c. is best Article 38. to be observ'd before, in, and after the Course ?

What are the Signs that the Water suits the Case, Article 39. and Constitution, of the Drinker ; whereby he may either be encouraged to proceed, or desist ?

What are the Inconveniencies, or Disorders, known Article 40. to happen, upon the first Days of drinking ; or during the Course, upon living irregularly, or taking the Water imprudently ?

What difference is there, with regard to the Cure Article 41. of Diseases, betwixt drinking the Water fresh, at the Well-Head ; or after it is carried a considerable distance from it ? And may not some Distempers require the one, and some the other ?

What difference is there betwixt drinking the Water Article 42. hot, or cold, with regard to different Diseases, Constitutions, and Ways of Living ? Or may not some Distempers require the one, and some the other ?

Can the Water be warmed, without losing part of Article 43. its Virtue ? If it can, how is this to be done ?

Article 44. May the Waters be advantageously used at Meals; or mixed and drank with Wine, Milk, &c. in some Cases?

30. The eighteen preceding Articles plainly regard Practice, and Use; and shou'd therefore be carefully prosecuted.

Article 45. Are there not already known, or may there not, from the Enquiry, be derived, certain Ways of heightening the Virtues of the Water; so as to render it more effectual in the Cure, or Relief, of some obstinate Diseases?

31. Thus, for example, if the Virtue chiefly required in the Cure of any Distemper, shou'd be found to reside in the Salt of the Water; cou'd not this Salt be separated from a large proportion of the Water, and added to a small one; so as to heighten the Virtue of the Water? Or, cou'd not its Virtues be increased, in other respects, by the addition of certain Tinctures, Solutions, or Impregnations, of Mineral Matters, of the same nature with the Contents of the Water, found by the Enquiry?

Article 46. What are the Virtues of the Water, used externally, or in the Way of Bathing?

A P P E N D I X,

For receiving more Heads of Enquiry, whether they fall under the three preceding general Divisions, or not.

Article 47. What are the Family-Uses of the Water?

32. The meaning here is to enquire how far the Water may be serviceable in Washing, Brewing, the making of Tea, Coffee, &c.

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May not the Water be particularly useful to Apothecaries, Chemists, Dyers, Tanners, Vitriol-makers, Soap-boilers, &c.? Article 48.

Has the Sediment, Mud, or earthy Matter, of the Spring, any external, medicinal Use; as in the Cure of schrophulous Swellings, Cancers, &c. or any curious Uses in particular Arts, or Trades? Article 49.

Can any Intimations of a Mine, or useful mineral Substance, be gain'd from the Enquiry; or can any new Uses be made of the mineral Matters found near the Confines of the Spring? Article 50.

33. Thus we have given a Summary of the more necessary Heads we can, at present, think of, before an entrance is made into the Enquiry itself; where more may happen to turn up; and either occasion the number to be enlarged, or shew that it may be lessen'd, by reducing two, or more, Heads to one; and pursuing them jointly. —

S E C T. III.

Of the Instruments, and Apparatus, necessary to the ENQUIRY.

1. Before we enter upon the Enquiry itself, it will be necessary to collect together the principal Instruments, and Apparatus, proposed to be used therein; that the Work may afterwards proceed with less interruption. And this may be done, by running over the Heads of Enquiry already laid down; to see what Instruments, and Apparatus are there pointed out.

2. And first, the Mariner's Compass may be useful, in determining the Situation of the Well, and the Course of the Water to the Receptacle:

because the Needle of this Compass pointing North and South (excepting for the Variation) the Enquirer may thence be enabled to lay down with exactness, the Course, or Windings, of the Streams, and the respective Situation of the adjacent Towns, or Country.

3. For examining the Water itself, its Contents, and the mineral Substances found near the Confines of the Well, or Course of the Water, there will be required ; (1) Exact Scales, and Weights ; (2) An Hydrostatical Balance ; (3) Variety of Glasses, common, and chemical ; (4) Cements ; (5) A Thermometer ; (6) A Hand-Pump ; (7) An Air-Pump ; (8) Microscopes ; (9) An armed Loadstone, or touched Plate of Iron ; (10) Distill'd Water ; (11) Crucibles ; (12) A melting Furnace ; (13) Fluxes, or Flux-Powders ; (14) Various Vegetables ; (15) Animal Matters ; (16) Minerals ; and (17) Artificial Substances.

4. (1) The Scales shou'd be of three sizes, all of them well made, for weighing Grains, Drams, and Ounces, or even a few Pounds : And the Weight employ'd shou'd be *Troy*, which is the medicinal, or Apothecaries, Weight ; the Pound whereof is twelve Ounces ; the Ounce divided into eight Drams, the Dram into three Scruples, and the Scruple into twenty Grains.

5. (2) The Hydrostatical Balance is an Instrument, or a certain Species of Scales, contrived to weigh Bodies in Water, so as to determine their specifick Gravity : as it also will do that of any mineral Water, by weighing a certain Glass-Bubble, therein, the weight of the Bubble, in the Air, and in common Water, being known before hand.

6. (3) The Glasses to be procured are (1) such as may commodiously exhibit the Water to the Eye,

Sect. III. *Apparatus for the ENQUIRY.*

Eye, and the Senses; and shou'd therefore be crystalline, and some of them cylindrical: (2) such as may bear Heat, and serve for Evaporation; these shou'd therefore be shallow, and widen upwards; (3) such as may confine the Water; as common Vials, Bottles, Glass-Eggs, and Bolt-Heads: and (4) such as may serve for Distillation; as Glass-Bodies, with Alembick-Heads, or Retorts and Receivers.

7. (4) By Cements are here meant those Matters, or artificial Compositions, which being applied to the Mouths of Glasses, tend to preserve the contain'd Water in a sound state, by keeping it from all communication with the external Air; such as melted Rosin, Sealing-Wax, or rather proper Mixtures of Wax, Turpentine, &c.
8. (5) A Thermometer is of use to determine the degree of warmth, or coldness, of the Water; being an Instrument consisting of a hollow Glass-Ball, with a long, and slender Neck, or Stem, filled to a certain height, with tinged Spirit of Wine; and divided into Degrees along the Stem; so as by the rising, or falling, of the Spirit of Wine therein, to shew the degree of Warmth, or Coolness, of any Fluid, wherein the Ball is placed.
9. (6) A small Hand-Pump, made either of Wood, or Tin, with its proper Embolus, or Sucker, is necessary to raise the Water immediately from near the Bottom of the Well; to shew whether this differs from that taken up near the upper Surface: tho' other Contrivances may also be used for this purpose.
10. (7) The Air-Pump, with its Glass Receivers, is a proper Instrument in helping to discover the proportion of Air, or volatile, fugitive Spirit, contain'd in the Water; for spiritu-

Apparatus for the ENQUIRY. Part I.

ous Waters are found to throw up, and discharge, a large quantity of Bubbles, when placed under the exhausted Receiver of the Air-Pump: and according to the greater or less number, and size, of the Bubbles thus discharged, the Water is judged to be more, or less, aerial, or spirituous.

11. (8) Microscopes, or Magnifying-Glasses, may be used in examining whether any visible component Particles can be found in a single Drop of the Water; but more successfully, perhaps, in determining the Figures of the Crystals, or Salts, of the Water, after Evaporation; or during the Time of Crystallization. It might also be proper to examine all the other solid, or visible, Contents of the Water, by the Microscope, both in a state of Mixture, and after they are separated from each other.
12. (9) The armed Loadstone, or touched Plate of Iron, is of use to discover whether any of the mineral Matters found near the Confines of the Well, or among the dry Contents of the Water, are of an irony nature: for whatever the armed Loadstone, or a touched Iron-Plate attracts, is generally allowed to be Iron. Tho' other Proofs of this, shou'd also be procured. And perhaps the Loadstone will not attract Iron in all States, and Circumstances; as unless it be pure, and perfect, or have all the Parts essential to malleable Iron: so that a mineral Substance may, possibly be irony, tho' the Loadstone shou'd not attract it.
13. (10) Distilled Water, or Water freed, as much as possible, from all mineral, saline, terrestrial, or other foreign Matters, is of use to discover the saline, or soluble, Contents of any mineral Substance, or dry Matter of a Mineral Water;

Water; by dissolving them from the less soluble parts, and giving them again, in a solid form, by Evaporation, or Crystallization. The Water shou'd be pure for this purpose; otherwise it might mix its own mineral, or saline, Matters, along with those of the Matter proposed to be examined; and so render the Experiment fallacious, or uncertain. Now, there is scarce a better way known of procuring Water in purity, than by gentle Distillation, in clean Glafs-Vessels.

14. (11) Crucibles, or melting-Pots, made of an earthy, or stony, matter, are useful in trying whether the dry Contents of a Water, or other mineral Substances, are metallick, or hold any considerable proportion of Metal: for if they do, the Metal may usually be got out of them, by powdering the Substance, and if necessary, mixing it with a proper Flux; then melting them together, in a strong Fire.
15. (12) A strong Fire is required to melt most metallick Substances; so as to separate the Metal from them; tho', in some Cases, a Wind-Furnace, that is, a melting Furnace, or Fire, animated barely with a current of Air, which it spontaneously draws to itself, is sufficient for this purpose. But where the Matter proves stubborn, or hard to melt, a Fire briskly agitated, or blown, with a pair of double Bellows, like those of the Silver-Smith, or Black-Smith, are usually required.
16. (13) Fluxes, or Flux-Powders, are any kind of Substance, which being added to a Mineral, or Ore, and melted therewith, causes it to run easier, and yield its Metal sooner, or in greater plenty, than it wou'd do when melted without addition. Thus Tartar, or Argol, Nitre, or Salt-Petre, Borax, Glafs of Lead,

Iron-Filings, &c. are Fluxes ; and shou'd be ready at hand, in order to the examination of the mineral Substances that may occur in the present Enquiry.

17. (14) Certain vegetable Matters are found to strike different Colours with different Liquors ; and according to the Colour produced, an Indication is obtained of one, or more, particular Substances contained in a Liquor. Thus, if fresh Violets be suffer'd to stand, for some time, in a pellucid Mineral Water ; and the Water should now appear of a red Colour ; hence an Indication wou'd be gain'd that an Acid is predominant in the Water ; but if a green Colour shou'd thus be produced, this denotes that an Alkali prevails in the Water : but if the Water retains the native blue Colour of the Violets ; this shews, that the Water is neutral ; or that neither an Acid, nor Alkali, prevails therein¹. The principal,

¹ By *Acid*, in the common Sense, is meant any Substance that tastes tart, or sour ; as Tamarinds, Cream of Tartar, Sorrel, the Juice of Lemmons, Verjuice, Vinegar, Spirit of Sulphur, Spirit of Nitre, Oil of Vitriol, &c. By *Alkali*, in the same Sense, is meant any Substance that, being mixed with an Acid, lessens, takes off, or destroys the acidity ; as Chalk, Limestone, Oyster-Shells, Crab's Eyes, the Earth of certain Mineral Waters, &c. or again, those called Alkaline Salts ; as Salt of Tartar, Salt of Pot-ash, fixed Nitre ; Salt of Hartshorn, Salt of Urine, &c. which, added in a sufficient Proportion, take off, or destroy, the acidity of Acids, and render the Mixture *neutral* ; that is, of such a nature, or temper, as manifests no Signs of a prevailing Acid, or Alkali. And here let it be observed, that Acids, tho' they agree in the property of Acidity, may yet greatly differ from each other in other respects ; as Vinegar and Lemon-Juice, Spirit of Nitre, and Oil of Vitriol, &c. And the same is to be understood of Alkalies, and Neutrals ; which tho' they agree in being alkaline, or neutral, respectively ; yet, in other Properties, they may differ as much as Alkali and Acid.

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therefore, of those vegetable Substances, which have the Faculty of indicating, by a change of Colour, the Contents of a Mineral Water, or other Liquor, shou'd be procured, and kept in readiness, for our purpose.

18. These vegetable Subjects, seem reducible to four Classes; viz. (1) Such as are Astringent, (2) of a fine Texture, (3) Purgative, and (4) Alterative.

19. (1) Among Astringents may be reckon'd Green-Tea, Oak-Leaves, Oak-Bark, Pomegranate-Bark, Balauſtian-Flowers, Sumach, but, more particularly, Galls: all which are adapted to discover whether the Water be of an irony nature, or contain any Particles of Iron, or the Vitriol of Iron. And this they do by turning such Water purple, black or dusky; and, with time, precipitating a light, dusky Cloud, or inky Substance, to the bottom. The Galls, for this purpose, shou'd be of the blue, or strongest kind, sound, and newly reduced to Powder; which may be kept in a Glass close stopp'd. This Powder is used with greater dispatch, convenience, and exactness, than a Tincture of Galls made in Water, which weakens their Virtue. The Tincture, besides, loses of its tinging Faculty by keeping; and at the same time acquires a deep colour, which may disturb the Experiments.

20. (2) Under Vegetables of a fine Texture come the colour'd, or colouring ones, which have their Colours easily alter'd by simple Mixture; such as the Flowers of Red Roses, Mallows, Violets, Blue-Bottles, Clove-July-Flowers, *Lignum Nephriticum*, &c. which serve to indicate, by the change of Colour they produce in the Water, what kind of saline, or earthy,

earthy, Matters predominate therein. Thus, as was before observed, Violets turn a Water red where an Acid presides; and green where an Alkali; but communicate their own blue Colour where the Water is neither acid, nor alkaline. And thus, pure common Water being neither acid, nor alkaline, an Infusion of these Flowers therein exhibits a beautiful blue Colour. And as pure crystalline Sugar, also, is neither acid, nor alkaline, the addition thereof to the Infusion of these Flowers, introduces no change of Colour: whence the Syrup of Violets may be commodiously substituted for the Flowers, in the making of our Experiments.

21. (3) The Purgative Vegetables, of use in our Enquiry, are chiefly Sena, Rhubarb, Hermodactyls, Mechoacan, Jalap, &c. and this by the way of simple Infusion, Tincture, or Decoction, to discover some certain Contents, or solutive Powers, of the Water; but more particularly the Salts thereof: for alkaline Salts are found, in all Trials, to heighten the Tinctures, or Virtues, of these purgative Ingredients; or make the Water take up more of their Parts, especially if they be unctious, or resinous. Neutral Salts are also found to have the like effect, in a less degree; whilst acid ones are little disposed to open the Bodies of these Drugs, or make them yield strong Tinctures.

22. (4) Those commonly called the Alterative, or Drying, Woods, as Guaiacum, Sassafras, Saunders, &c. may be likewise serviceable in this Enquiry; and help to discover the Contents of the Water; as they will yield their Virtues to some Waters better than to others; particularly to such as abound with a Salt capable

pable of dissolving their resinous, or unctuous Parts; wherein their medicinal Virtue principally appears to consist. And by this means also some new Uses of the Water may, probably, be discovered; viz. by applying it to the making of Infusions, Decoctions, or Extracts, of various Drugs, or Simples.

23. (15) It is of importance in the Enquiry to know how the Water affects the animal Fluids, or other animal Substances; as this may not only give Light into the Contents of the Water, but also afford Directions for its prudent use; and shew what effects may be rationally expected from drinking it. And here we shou'd principally regard the Changes it produces in the fresh extravasated Blood of a healthy Person; in coagulated, or dry, healthy human Blood; in the Serum of sound Blood; in morbid Blood of various kinds, as that of rheumatick, scorbutick, pleuretick, consumptive, hypochondriacal, and maniacal Persons; upon the *Calculus humanus*, or Stone of the Bladder; upon Gall-stones; upon the chalk-stones of Gouty Persons; upon Matter, or Pus; upon Urine, recent, stale, and gravelly, &c. upon viscid Phlegm, gellied Lympha, or other sound and morbid animal Substances; especially as assisted with a degree of Heat equal to that of the human Body.

24. (16) It may be proper to mix different kinds of Minerals with the Water, to try if any remarkable Changes can be thereby produced; or the Virtues of the Water increased; or its Contents the better discover'd. And, in this View, several Ores, especially the softer, or more soluble, sorts, might be used; especially Iron-Ore, Mundick, Marcasites, or the Pyrites; as also Lime-stone, Alum-stone, Vitriol,

Vitriol, Sulphur, and the mineral Salts. Any of these Matters, if made to dissolve in the Water, might produce considerable Changes therein; or increase its Virtues, if they depended upon Contents of the same kind. Thus, for example, if any part of the Virtue of the Water shou'd depend upon Iron, the artificial introduction of more Iron might heighten the Virtue of the Water. And so, again, if Vitriol, Alum, or Sulphur, be naturally contain'd in the Water; these Minerals might be added to it, in a proper manner. So again, it may be proper to try whether pure Silver will change its colour, or turn black, in the Water; or whether Lead, Quicksilver, &c. will, any way, dissolve therein: whereby a knowledge may be gain'd of certain Contents, or Properties, of the Water.

25. (17) The Head of Artificial Substances might admit of great variety: but we will here single out the more necessary Particulars, under the Classes of (1) Alkalies; (2) Acids, and (3) Metallick Preparations, and Solutions.

26. (1) By Alkalies are here meant what the Chemists call'd fix'd and volatile alkaline Salts, and Spirits. Fix'd alkaline Salts are made by boiling the white Ashes of proper vegetable Subjects, such as common Billet-Wood, Bean-Stalks, Vine-Cuttings, Tartar, &c. in Water, to dissolve the Salt out of the Ashes; then evaporating the clear Solution, till a dry Salt be left behind. Salt of Tartar is a principal Salt of this kind, and has considerable uses in the examination of Mineral Waters: for as it dissolves more readily, and fully, in Water, than any earthy Substance; in proportion as it dissolves, the earthy Substance, contain'd in the Water, will fall to the bottom;

tom ; so that, by this Expedient, a large quantity of the Earth of a Mineral Water may be separated ; and made to assume a dry form. And as this Salt is alkaline ; if the Water be acid, some conflict, or ebullition, may be expected upon mixing them together : for this is commonly the case when an Acid and Alkali are mixed. Or, by a prudent addition of this Salt, so as just to take off the acidity of the Water, a neutral Salt may be made, and, by a proper Treatment, render'd sensible ; so as to afford a satisfactory Proof that the Water was acid. Salt of Tartar also readily runs, by the moisture of the Air, into a ponderous Liquid, called Oil of Tartar *per deliquium* ; which may often be used with greater convenience than the Salt itself ; as it is purer, more easily unites with Water, and may be more commodiously dropp'd into it. But if either the Earth, or Acid of a Water, shou'd be light, fine, or almost imperceptible ; so as not to manifest themselves upon the addition of a strong Alkali ; a milder sort may be required ; such as those called volatile alkaline Salts, or urinous Spirits ; viz. the Salts, or Spirits, of Hartshorn, Blood, Urine, &c.

27. (2) We must likewise be provided of those called mineral Acids, or artificial acid-Spirits ; such as the Spirit, and Oil, of Vitriol ; Spirit of Sulphur, made by the Bell ; Spirit of Salt ; Spirit of Nitre, &c. for these Acids serve to discover whether the Water be alkaline. Thus, for example, as Oil of Vitriol is a very strong Acid, a drop, or two, whereof will communicate a perceptible acidity to four or five ounces of common Water ; if a drop, or two, of this Acid give no perceptible acidity to four or five ounces of a mineral Water ; it will hence
appear

appear that the Mineral Water is alkaline; or impregnated with something that has a power to blunt Acids, or destroy, their acid nature, and turn them neutral. But where only a light, or subtile, Alkali is contain'd in a Mineral Water, lighter Acids may be used for the purpose; such as Lemmon-Juice, distill'd Vinegar, *Rhenish* Wine, &c.

28. (3) The Metallick Solutions, or Preparations, usually made by Chemists, will be of considerable Service; not only as they may confirm the Conclusions drawn from other Experiments; but also discover still more of the Contents, and Properties of the Water. Some of the most necessary ones are the following, viz. (1) A Solution of Corrosive Sublimate in distill'd Water; (2) A Solution of pure Silver in *Aqua fortis*; (3) A Solution of Quick-silver in *Aqua fortis*; (4) A Solution of *Saccharum Saturni*, or Sugar of Lead, in Water; (5) A Solution of Gold, in *Aqua regia*; (6) A Solution of Copper, in *Aqua fortis*; and another of the same Metal, in Spirit of Sal-ammoniac; (7) A Solution of Iron, in *Aqua fortis*; and another of the same Metal, in distill'd Vinegar, or any tart Wine: the uses of all which will appear in the Course of the Enquiry.

S E C T. IV.

Of the Experiments to be used in the ENQUIRY.

1. The Design of the present Section is to shew the possibility of making an exact, and satisfactory, Enquiry, into the Contents of a Mineral Water; for, till this also is shewn, we shall not be prepared to enter upon the Enquiry itself: as
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the Business of examining Mineral Waters has not hitherto, that we know of, been reduced to the form of an Art; or brought under the Laws of physical Demonstration. Some Attempts, indeed, have been made in this way; but they are so imperfect as to leave many strong Objections upon the Minds of the major part of Naturalists, Physicians, and Chemists. The Reason appears to have been this; that the Experiments hitherto offer'd, for determining the Contents of Mineral Waters, are generally slight, and superficial; or by no means, fully verified, and carried on, in the form of Induction.

2. By Induction we mean the Art of Enquiry, originally invented by the Lord Chancellor *Bacon*; and, in good measure, deliver'd by him, (tho' never perfected) in the second Book of his *Novum Organum*. This Art is no more than a rational, or scientific Method, of investigating, or tracing out, the Natures of Things; so as to manifest by what Laws, Means, or Actions, they physically exist, and produce their Effects. It appears in all respects to be the best, or most certain, if not the only true, Art hitherto known, of promoting physical Knowledge; provided it be practised with that Caution, and according to those Rules which itself delivers. The principal Uses of it are to shew what Method shou'd be observed; and what Experiments, or Observations, are to be made, in every Subject; how they are to be applied; what Particulars they bring to Light; or what Discoveries they afford: nor does this Art obtain its End, till certain Axioms, or general Conclusions, are formed, by its means; comprehending the Nature of the Subject, and directing to an extensive Practice upon it. This Art, therefore, consists in a prudent, and suitable use of the Invention, the Memory, Rea-

Reasoning, and Experiment, all improved and assisted to the utmost ; where Invention directs the Articles of Enquiry, Reasoning directs the Experiments, and the Experiments, when made, inform and farther direct the Invention, and the Reason ; so as to point out other Experiments, till the Nature of the Subject is fully discover'd. Thus, in the present Undertaking, this Art has directed the Invention, the Reason, and the Memory, to cast about, and suggest, the first Heads of Enquiry ; and the Experiments to be made ; but can proceed no farther till the Experiments themselves are made ; or the Answers gain'd, from Nature, to the Questions proposed ; after which, the Reason, from the new Light acquired, may direct farther Experiments, till thus the Enquiry is brought to a Conclusion.

3. The present Business is, therefore, to explain the Nature of the Experiments, already pointed out by our Articles of Enquiry ; with the Way of conducting them, according to the Art abovementioned ; that they may give a clear and just Information ; and not lead us into Error, and Confusion. But to do this in the amplest, and most satisfactory Manner, wou'd require an exactness, or scrupulousness, of Procedure which might disgust any but mathematical Readers ; and draw us into a Length unsuitable to the present Design. Tho' as the Thing is of the utmost importance, not only to the present Enquiry, but likewise to all others of the like kind ; it may be proper to dwell a little upon it ; with a view to shew, by way of Example, what Rigour is required, and what Evidence, or Proofs, may be had, in physical Enquiries, and the Examination of Mineral Waters.

4. The End of our present Enquiry is to discover the Contents, Virtues, and Uses, of a certain Mineral Water; but as the Virtues, and Uses of this Water must necessarily depend upon its Contents, Ingredients, or the Parts whereof it consists; the principal Drift, and Scope, of the Enquiry must be to discover, or, as far as possible, to manifest these Contents, and bring them under the Cognizance of the Senses, or Reason.

5. And here it comes first to be consider'd, from the apparent Nature of the Thing; and from some knowledge of the Properties of common Water, and the Substances capable of dissolving therein; with what kinds of Matters the present Mineral Water is likely to be impregnated. Now it is self-evident, that the Contents of every Water must be such as are capable of lodging therein, without hindering its transparency; and without giving it Properties different from those found in it by the Senses, or particular Experiments; otherwise it would not be the Water it is.

6. Mineral Waters are generally understood to be those running Waters, which receive any remarkable Quality, or Property, in the Earth, whereby they differ from common Water; and thence become either more beneficial than that, in the Cure, or Relief, of certain Diseases, or else more noxious, or prejudicial to the Body. By which Definition, the Contents of Mineral Waters, seem, as the name imports, limited to Subjects of the Mineral Kingdom. But as just Definitions can never be given, till the Natures of Things are discover'd, we shall make no farther use of the present one, than to direct our Enquiry, more particularly, to the discovery of Mineral Matters in the Water; tho' without

neglecting such as may be of a vegetable, or animal, nature. For, as vegetable, and animal Matters plentifully abound in the Earth, and may lie in the Course, or Confines, of a Spring; it is not impossible that certain parts thereof shou'd, at some times, or in some places, mix with the Water.

7. But, to shorten our present Labour, it may be proper to contract our View, and here limit ourselves to such Things only, as Water is commonly known to dissolve; and such as have been found, by competent Trials, to exist in Mineral Waters: for we do not here undertake to write a System of natural, and chemical Philosophy; but to shew the Way of pursuing a particular Enquiry into Mineral Waters, by means of suitable Experiments.

8. The Bodies capable of permanently dissolving in Water, without hindering its transparency, and such as have been found to exist in Mineral Waters, seem reducible to four Classes; viz. (1) *Salts*; (2) *Earths*; (3) *Sulphurs*; and (4) *Fumes*, or *Spirits*. Now, the Question here is, whether natural Philosophy, and Chemistry, even in their present States, may not supply Ways of discovering, with physical Certainty, if any of these are, or are not, contain'd in a Mineral Water. From several Observations and Experiments, which we have ourselves made, and some also that we have read, we incline to think this possible; and now proceed to lay down the Ways wherein we judge it may be effected.

I. S A L T S.

9. All true Salts dissolve in Water; this being one of their essential Properties, or Characteristicks; and as there are few Mineral Waters

ters but what, upon a common Analysis, are found to contain a saline Substance; and as the principal Virtue of these Waters is sometimes found to reside therein; a primary regard shou'd be had to discover, whether a proposed Mineral Water contains any Salt; to determine the Species thereof, if known, assign its proportion to the Water, or to the other Ingredients; describe its particular Properties, Virtues, and Uses; and produce, or exhibit, such Salt, or Salts, in their natural, or true form, and appearance.

10. The natural Mineral Salts, or Salts supposed to be Mineral, are (1) Sea-Salt, or common Salt, (2) Nitre, (3) Alum, (4) Borax, (5) Sal-Ammoniac, (6) *Epsom* Salt, or the *Sal Catharticum amarum*, (7) *Dr. Lister's Nitrum Murale*, or Calcarious Nitre, (8) The universal Acid, and (9) The mineral alkaline Salt.

(I) SEA-SALT.

11. In order to discover whether Sea-Salt, or any other known Salt, be naturally contained in a Mineral Water, it is previously necessary to be acquainted with the Natures, and Properties, of these Salts; otherwise we might be at a loss to know them, when they come in our way.

12. Some of the chief Properties of Sea-Salt, as distinguish'd from all other known Salts, seem to be these; viz. (1) Its particular appearance; its saline taste; and its form, being either that of Grains, or cubical Crystals, when true shot. (2) Its preserving Quality; especially with regard to animal Flesh. (3) Its manner of decrepitating, or crackling, in, or over, the Fire; and increasing the strength thereof, when sprinkled upon live Coals. (4) The particular Odour

it yields in this Decrepitation ; being that of the Spirit of Salt. (5) Its affording the true Spirit of Salt, in a dense, white, pungent, Vapour, by Distillation ; which Spirit, as well as the Salt in substance, turns *Aqua fortis* into *Aqua regia*, and thus makes a Solvent for Gold. (6) Its melting with difficulty in a strong Fire ; and at length passing thro' the Pores of the Crucible. (7) Its being recoverable from its own Spirit, by the addition of any pure and fix'd alkaline Salt. (8) Its Spirit constituting Sal-ammoniac with any volatile Alkali ; or the Salt itself affording Sal-ammoniac, by Sublimation, after being digested with Urine. (9) Its remaining dissolved by common Water, in the proportion of about six ounces to a Pint. And (10) its faculty of precipitating Silver dissolved in *Aqua fortis* ; so as to increase the weight of the Silver, and render it volatile in a strong Fire. A previous knowledge of these Properties of Sea-Salt may sufficiently enable us to discover it in a Mineral Water ; or under whatever form, or disguise, it may happen to be met with.

13. The known Ways of discovering whether Sea-Salt be contain'd in a Water, seem reducible to these three ; viz. (1) Addition to the Water ; (2) Evaporation, and Addition to the dry Matter ; and (3) CrySTALLIZATION.

(1) *By Addition to the Water.*

14. *Case I.]* To two ounces of pure distill'd common Water, contain'd in a white, crystalline, cylindrical Glass, add, drop by drop, four Grains of a pellucid Solution of Silver, made in *Aqua fortis*, with one ounce of refined Silver to four ounces of proof *Aqua fortis* ; and no Milkiness, Cloudiness, Change of Colour, or Transparency will appear in the Water.

15. *Case II.]*

15. *Case II.*] To two ounces of the same distill'd Water add a single Grain of Sea-Salt, let it perfectly dissolve therein, by stirring the whole together with a clean Glass Rod; and now dropping in four Grains of the same Solution of Silver, a manifest Milkiness, or white Cloudiness, will appear in the Water, or a white Precipitate fall to the bottom of the Glass.

16. " Now, as nothing was added in the second
" Case, more than in the first, besides a single
" Grain of Sea-Salt; it is manifest that the
" Solution of Silver, by causing a Milkiness,
" or white Precipitate, gives an Indication
" of the Sea-Salt added to the Water
" in the second Case. Therefore, when
" such a Solution of Silver causes no change
" in a suitable proportion of a Water;
" it may hence be suspected that the Water
" contains extremely little, or no Sea-Salt;
" but if a Milkiness, or white Precipitate
" ensues, that some proportion of Sea-Salt
" is lodged therein."

17. " The Chemical Reason of the Experiment
" is this; that Silver remains permanently
" dissolved in its proper Menstruum, *Aqua*
" *fortis*; and by no means so in the Solvent of
" Gold, or *Aqua regia*; which will not touch
" Silver, but constantly precipitates it from
" its own Solvent *Aqua fortis*, on account of
" the Sea-Salt, or Spirit of Sea-Salt, contain'd
" in *Aqua regia*; which constitutes the sole
" difference betwixt the two Menstruums.
" And, therefore, when a Solution of Silver,
" made in *Aqua fortis*, is added to pure di-
" still'd Water, which contains no Sea-Salt,
" it mixes intimately therewith; the Silver
" here also remaining transparently dissolved,
" and equally suspended, and dispersed thro'

“ the whole. But upon the addition of Sea-
 “ Salt, which turns the Liquor into an *Aqua*
 “ *regia*, the Silver is immediately set loose,
 “ the Mixture grows white, or milky; and
 “ lets the Silver fall, according to its nature,
 “ in a white Powder, or Precipitate, to the
 “ bottom.”

18. *Case III.*] To the like quantities of the same Water, contain'd in several Glasses, separately add a Grain of pure Nitre, pure Alum, and pure Borax; in all which there is no mixture of Sea-Salt; and into each Glass let fall the Solution of Silver, as before; upon which no change of Colour, or Transparency, will ensue; nor any Precipitation be made. And this appears to hold of all the Salts wherein no Sea-Salt is contained.

19. *Case IV.*] Mix together, in a clean Glass Mortar, equal, or unequal, parts of pure Nitre, pure Borax, and pure Alum, wherein there is no Sea-Salt lodged; put four Grains of this Mixture into two ounces of the distill'd Water; let the whole entirely dissolve therein; then add the Solution of Silver, as before, and still no Milkiness, or Precipitation, like that in the second Case, will appear. And this also seems to hold of any Mixture of Salts, provided there be no Sea-Salt among them.

20. “ These four Cases, when duly consider'd,
 “ and compared, will shew that a Solution of
 “ Silver, in *Aqua fortis*, is a ready, an exact,
 “ and commodious Thing, for intimating
 “ whether there be, or be not, any consider-
 “ able, or even minute, proportion of Sea-
 “ Salt contain'd in a Water. The same may
 “ likewise be done by a Solution of Quick-
 “ silver, in *Aqua fortis*, or an aqueous Solu-
 “ tion of Sugar of Lead; tho' not in so ex-
 “ quisite,

“ quifite, and perfect, a manner. This kind
“ of Proof, may fometimes, indeed, happen
“ to be fallacious, incompetent, or insuffi-
“ cient; becaufe other Salts, or Subftances,
“ whose natures and properties, are not hi-
“ therto known, may poffibly be able to
“ precipitate Silver in Solution, as well as
“ Sea-Salt does. Whence fuch kind of Tri-
“ als fhould not be propofed as demonftra-
“ tive; but only as probable. All the In-
“ ference, therefore, to be juftly made from
“ them, before they are otherwife verified, or
“ confirm’d, is, that, fince it muft, with re-
“ gard to the truth of the Experiment, be the
“ fame thing whether Sea-Salt is added to a
“ Water by Nature, by Accident, or the
“ Hand of Man, provided it be in the Wa-
“ ter; we may hence be furnifhed with a
“ probable Indication whether any Sea-Salt,
“ even in a fmall proportion, be contain’d in
“ a Water, or not. We now proceed to
“ more direct, and infallible Proofs.”

(2) *By Evaporation, and Addition to the dry Matter.*

21, *Case I.*] To half a Pint of diftill’d common Water add a Dram, or two, of Sea-Salt; which being totally diffolved therein, evaporate the Solution, over a clear Fire, till a dry Matter remains at the bottom. This dry Matter will, upon all Trials, be found to be Sea-Salt. Thus, for example, lay a part of it upon a piece of clean Glafs, and add to it a few drops of well rectified Oil of Vitriol; and a confiderable Heat, and Ebullition, will enfue; and a particular, white, pungent, Vapour, or Steam, arife, having the exact Smell of *Glauber’s* strong Spirit of Sea-Salt. Now, as no other Salt, unlefs it contains Sea-Salt, or

the Spirit of Sea-Salt, is found, upon the like Experiment, to afford this particular Vapour, and Odour; we have hence a clear Indication that Sea-Salt was contain'd in the dry Matter. And by adding a sufficient proportion of distill'd Water to this Matter, then evaporating the Solution, the Salt may be easily recover'd in its own pristine form.

22. *Case II.*] As Nitre, and Sea-Salt, may happen to be mix'd in a Water; and as both of them afford their respective Vapours, or Spirits, upon contact with Oil of Vitriol; dissolve equal parts of these two Salts in distill'd Water, and exhaling the superfluous Moisture, put the dry Matter into a Retort; and adding Oil of Vitriol to it, distil, in a Sand-Heat; whereby a true *Aqua regia* will be obtain'd; that is a Mixture of the Spirit of Nitre, and the Spirit of Sea-Salt; both which Spirits are thus made to rise in Vapour, and come over, mix'd, into the Receiver: whence we have a clear Indication that both Sea-Salt and Nitre were contain'd in the Mixture; since no other Matters, besides these two, in conjunction, are found to afford the true *Aqua regia*.

23. *Case III.*] Mix together equal, or unequal quantities of Sea-Salt, Salt of Tartar, *Epsom* Salt, Borax, and Alum; add a proper proportion of Oil of Vitriol thereto; and the peculiar, white, pungent Vapour of Sea-Salt will immediately arise, and give a plain Indication that Sea-Salt was contain'd in the Mixture. And this appears to hold of any other Mixture of different Salts with Sea-Salt; excepting Nitre, whose Mixture with Sea-Salt was consider'd under the second Case: for Nitre upon contact with Oil of Vitriol, yields
its

its own peculiar Vapour, or the Fume of Spirit of Nitre; easily distinguishable from all others.

24. *Case IV.*] Mix together equal, or unequal, parts of Sea-Salt, Bole *Armoniac*, Chalk, and Brick-dust; then pouring Oil of Vitriol there-to, the peculiar Vapour, and Odour, of the Spirit of Sea-Salt, may still be remarkably observed, and distinguish'd. And this Experiment, also, appears to hold of the Mixture of Sea-Salt with any other stony, earthy, or mineral Substances.

25. " If this kind of Proof, depending upon
" the knowledge of the Smell, and Appearance, of a certain Fume, or Vapour, shou'd
" be thought precarious, or inconclusive; as
" it may be by those who are unacquainted
" with the peculiar Sensation constantly impress'd by the Fume, or Spirit, of Sea-Salt,
" striking the Nostrils of any Person who has
" his Smell; the Experiment may be farther
" prosecuted, and render'd more satisfactory,
" and conclusive: for if the Mixtures affording this Odour, be distill'd, in a Glass Retort, and Receiver, with a sufficient quantity of Oil of Vitriol, they will afford the
" true Spirit of Sea-Salt, according to all
" Trials; and particularly by this, that it is
" convertible into Sea-Salt again, by the
" proper addition of any fix'd alkaline Salt."

26. " The Chemical Foundation, whereon the
" Success of these Experiments, with Oil of Vitriol, depends, is this; that Oil of Vitriol, being a strong Acid, and powerfully
" disposed to act upon Sea-Salt, and Nitre,
" so as to enter forcibly into their more fix'd,
" or gross, parts; at the same time that this
" is done, their lighter, or more volatile
" parts,

The Experiments to be used. Part I.

“ parts, are loosed from their connection with
 “ the grosser, and left free to rise, according
 “ to their lighter nature; and thus in proper
 “ distilling Vessels, come totally over the
 “ Helm, with the assistance of Heat; leaving
 “ the more ponderous, and terrestrial, Matter
 “ behind, closely united with the Oil of Vi-
 “ triol; as we see in the distillation of *Glauber's*
 “ strong Spirit of Sea-Salt, and Spirit of
 “ Nitre.”

(3) *By Crystallization.*

27. *Case I.*] Dissolve any proportion of Sea-Salt in distill'd Water; evaporate the Solution till a Film, or Skin, appears on the Surface; then put the Liquor into a clean, earthen Vessel; set it to shoot in a cool Place; and in a few days time, great part of the Salt will be found grain'd; or if the Solution were not too high boiled, and a sufficient time was afforded, shot into Crystals, of a cubical figure.
28. *Case II.*] Mix equal, or unequal, Parts of Sea-Salt, Nitre, and *Epsom* Salt, by grinding them together in a clean Mortar; dissolve the whole in distill'd Water; evaporate the Solution over a clear Fire, till a Film appears on the Surface; then set the Liquor in a cool place for some days, and the Nitre will be found to shoot first, in its natural Crystals; which being taken out, and the remaining Liquor again boiled, to a proper height, and exposed to shoot, as before; the Sea-Salt will be next obtained, in its own peculiar Grains, or Crystals. And if the Experiment be carried farther, by boiling the Liquor again, and setting it to shoot, the *Epsom* Salt will likewise be obtained. In the same manner may any Mixture of different Salts be separated,
 each

each in its own particular form, or Crystals. The Rule in Crystallization is this, that the Salt which dissolves most copiously in Water, shoots first out of the Mixture; and that which dissolves the most sparingly, first: whence Nitre shoots before Sea-Salt, and Sea-Salt before *Epsom* Salt.

29. " This last Method of Trial, by Crystallization, may of itself be esteem'd certain, " or satisfactory; but joined with the two " former, by Addition to the Water, and by " Evaporation, and Addition to the dry " Matter, it amounts to a physical Demonstration: so that where they all agree there " can be no doubt that Sea-Salt is contained " in a Mineral Water, treated after the same " Manner: for the first affords an Intimation that this Salt is naturally contained in " the Water; the second shews that it remains after Evaporation; and the third " that it is actually separable, in its own proper form, from the Water; and may in this " State be fairly examin'd, to try whether it " has, or has not the known Properties of " Sea-Salt. If any Scruple, or Suspicion, " shou'd remain, as to its being Sea-Salt, let " it be strictly compared with a parcel allow'd to be Sea-Salt, in all respects, according to the Characteristicks above given " of this Salt; and if no difference appears " betwixt the two, they must, at least be acknowledged of the same kind."

30. " It might, indeed, be here objected, that " though Sea-Salt shou'd be contain'd in a " Water, yet Nature may have so intimately, " or, as it were, undistinguishably, and inseparably, blended or mix'd, it in with the " Water, or other Contents, as not to mani-
fest

“ test itself upon the severest Trials ; as fix’d
“ alkaline Salt is concealed in Glass, Acid in
“ Flint, or Sulphur and Mercury in Metals;
“ or as other Principles are in those emphatically
“ called Mixts, to distinguish them
“ from Aggregates, or Compounds, where
“ the Texture is loose, and the Parts much
“ more easily separated. And this Objection
“ must be allow’d of force, in some Cases,
“ till we can shew that even these Mixts can
“ be separated by Art, or have their Ingredients
“ render’d cognizable by the Senses,
“ or the Reason. This, indeed, belongs to
“ a higher Chemistry than we are at present
“ concern’d with ; otherwise it might be
“ made appear that Mixts, with regard to
“ their Analysis, differ not from Compounds,
“ provided we were furnish’d with suitable
“ analysing Powers, Instruments, and Menstruums.
“ Thus Glass may be, without
“ much difficulty, separated into the Sand,
“ and fix’d Salt that compose it ; and Flints
“ have their Acid separated from them, in
“ the making of Glass ; as we see in that
“ Substance called, at the Glass-Houses, Sandiver ;
“ and even the purer Metals may be
“ analysed by the Burning-Glass, and otherwise :
“ But there is no occasion to go thus
“ far for an answer to the present Objection,
“ in the Case of Mineral Waters, till it can
“ be shewn that Nature has made any such
“ firm Mixtures, as those abovementioned, in
“ Mineral Waters : on the Contrary, numerous
“ Experiments shew that the Principles here lie
“ loose, and may be separated, by ordinary Means,
“ to such a degree of Simplicity as clearly to
“ manifest their physical, and medicinal Effects, Virtues,
“ and

“ and Uses; wherein our present Enquiry
 “ centers. We therefore, presume that the
 “ preceding Experiments duly applied, and
 “ consider’d, furnish us with a sure Method
 “ to discover whether any Mineral Water
 “ contains Sea-Salt, and if it does, to separate it from all other Things; render it
 “ sensible, and determine its proportion.”

31. “ We have been the fuller upon this first
 “ Article of Sea-Salt, to shew an Example of
 “ the inductive Method which we wou’d recommend in Experiments, and particularly
 “ in prosecuting Enquiries of this kind;
 “ where the Foundations of physical Certainty have scarce hitherto been laid. And,
 “ hoping there may be enough done in this
 “ strict Way, to shew the Nature of the Procedure intended, we shall, for fear of being
 “ thought too minute, and tedious, by frequently and circumstantially, repeating the
 “ same kind of Experiments, endeavour to
 “ dispatch the remaining Part in a more
 “ concise, and summary Manner.”

II. N I T R E.

32. The Characteristicks of pure Nitre, or Salt-Petre, seem to be chiefly these: viz. (1) Its peculiar form, or hexagonal, prismatick Crystals; pyramidal at one end, when the shoots are true, and perfect. (2) Its particular sharp, or penetrating, cool, and lightly bitterish taste. (3) Its preserving Flesh; and at the same time giving it a particular florid, or rosy Colour: whereto may be added its improving the red Colour of the Blood; especially when inclined to be white, black, or fizy. (4) Its cooling the Body, and lowering the Pulse; more remarkably in Fevers, and Pleurifies. (5) Its yielding a red,
 suffoca-

suffocating Fume, or Vapour, in distillation ; and thus affording a true *Aqua fortis*, or Spirit of Nitre ; which is a Solvent for Silver, but not, of itself, for Gold. (6) Its manner of flowing, or melting, in a Crucible, in the Fire ; which is quick, and igneous ; tho' this Salt does not of itself take Flame, in the strongest Heat. (7.) Its fulminating, and turning to a fix'd alkaline Salt, in Fusion, upon the addition of Charcoal, Tartar, &c. with a considerable loss of weight. (8) Its composing Gunpowder with common Brimstone, and Charcoal. (9) Its being recoverable from its own acid Spirit, by the proper addition of any fix'd, alkaline Salt.

33. These Properties of Nitre being laid down, it is easy to try if any Salt, supposed to be nitrous, whether found in a Mineral Water, or otherwise, be real Nitre, or not. And hence it is manifest that by Nitre, or Salt-Petre, we do not mean the *Nitrum Murale*, or calcarious Nitre, of Dr. Lister ; whose Properties will hereafter be deliver'd ; nor the Nitre of the Ancients, which appears to have been a very different Thing, of an alkaline nature ; but our common, refined, Salt-Petre, used in Medicine, Chemistry, and the making of Gun-powder ; being a neutral Salt, with regard to Alkali, and Acid ; tho' resolvable, by Fire, and proper Additions, into a strong Alkali, and a strong Acid.

34. The Ways of discovering whether this Nitre be contain'd in a Water, seem reducible to four ; viz. (1) by Immersion, or Steeping certain Bodies in the Water ; (2) By Evaporation, and Addition to the dry Matter ; (3) By Distillation, with Additions ; and (4) by Crystallization.

(1) By

(1) *By Immersion, or Steeping.*

35. If a little Nitre be dissolved in distill'd Water, and Paper be steep'd a while in the Solution, then dried before the Fire; and if there be occasion, dipp'd, and dried again; the Paper being now applied to a lighted Candle, or glowing Coal, will immediately take Fire, tho' not flame; and burn, like Quick-match, in a certain sparkling manner; so as to give a manifest Sign that it receiv'd this Property from Salt-Petre: for Paper steep'd in the like Solutions of Alum, *Epsom-Salt*, fix'd alkaline Salts, Vitriol, Borax, *Nitrum murale*, Sea-Salt, or any other of the known Salts, will not produce the same Phænomenon. Whence, if Paper, several times steep'd in a Mineral Water, shou'd produce this Effect, or burn after the same particular manner; this wou'd be an Indication that the Water contain'd Nitre.
36. " The Reason of the Experiment scarce
 " needs to be mentioned, as it is obvious,
 " that the Paper by being soaked in the So-
 " lution, becomes impregnated with the Wa-
 " ter, and of course Particles of the Salt; and
 " being afterwards dried, the aqueous Parts
 " thus exhale, and leave the particles of the
 " Salt sticking in the Pores of the Paper;
 " which being now applied to the Candle,
 " it takes fire, and burns, or makes little fiery
 " explosions, according to the well known
 " property of Nitre; when mix'd, and ful-
 " minated, with any inflammable Substance.
 " But as this Effect may possibly be prevent-
 " ed, or not so remarkably follow, if other
 " Salts shou'd happen to be mix'd, in too large
 " a proportion, along with the Nitre; the
 " fol-

“ following Case may help us to discover Nitre where it is blended with other Salts.”

37. If equal, or unequal, quantities of Nitre, Sea-Salt, *Epsom* Salt, and Borax, be dissolv'd in distill'd Water, and a piece of raw flesh be steeped in the Solution for some hours, and then taken out and examin'd, or compared with a piece of the same raw Flesh, which has not undergone the same Operation, the former will be found redder than the latter; or than another piece of the same Flesh, set to steep, for the same time, in a Solution of the several Salts abovemention'd, except the Nitre: whence it follows, that Nitre, according to its known property, was the Cause of this additional Redness. If, therefore, Mineral Water shou'd have the same Effect upon raw Flesh steep'd therein, we may presume that the Water contains Nitre.

38. “ It shou'd seem that Nitre gives this particular red, or rosy, Colour to raw Flesh, on account of some of the Blood still remaining therein: for Nitre acts powerfully upon Blood; so as to heighten its Colour, and long preserve it fresh, and sound, even when stagnant, or extravasated. But to determine this Matter, it might be proper to try, whether a Muscle, so well washed, and cleansed, from its Blood, (by soaking in fair Water, by Injections into the Blood-Vessels, or otherwise) as to appear white, cou'd have any degree of redness restor'd to it by Nitre; or whether it will turn a Tendron or other white animal Substance red.

Se^{ct}. IV. *The Experiments to be used.*

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(2) *By Evaporation, and Addition to the dry Matter.*

39. If Nitre be dissolved in Water, and the Solution evaporated to dryness, the Nitre will remain behind; and may be proved to be Nitre, by mixing it with powder'd Charcoal, and trying if it will fulminate, and turn to an alkaline Salt, in the Fire; if it will make Gunpowder with Brimstone and Willow Coal; or if it will afford the peculiar red Fume of a particular, nauseous, suffocating odour, like that of *Aqua fortis*, by pouring Oil of Vitriol to it. And, in the same manner, tho' Nitre shou'd be mix'd with several other Salts, in a Water; after Evaporation to a dry Substance, Indications may be gain'd of its being among them; but particularly by adding Oil of Vitriol to the compound Mass, and observing, and examining, the Fume, and Odour, thence arising.

(3) *By Distillation.*

40. So again, if Nitre, after the full Evaporation of any Water, remains mix'd among the dry Matter, it may be discover'd, by adding either Oil of Vitriol, calcined Vitriol, or Brickduft, thereto; and distilling, in a naked Fire; for thus the Nitre parting easily with its Spirit, this Spirit will soon rise, and come over, in red Fumes, into the Receiver. Only, if Sea-Salt happens to be in the Mixture, there may thus be obtain'd an *Aqua regia*, instead of a pure Spirit of Nitre; tho' this also gives a sufficient Indication of the Nitre; as *Aqua regia* cannot be made without the Spirit of Nitre. To carry the Proof farther, let trial be made whether, by adding a sufficient proportion

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portion of any fix'd alkaline Salt, to the Spirit thus procured, true Nitre may not be recover'd; and whether this Nitre, in particular, will not serve in the making of Gunpowder; because it has been suspected that regenerated Nitre will not.

(4) *By Crystallization.*

41. It need not be mention'd, after what has been said before, of Crystallization, that a simple Solution of Nitre in Water, being brought to a due height, and set in a cool place, will in a few days, shoot into hexagonal, prismatick Crystals of pure Nitre. So that, if any Mineral Water shou'd contain no Salt but Nitre, this may easily be obtain'd from it, by a proper Evaporation, and subsequent Crystallization. Again, tho' several other Salts, besides Nitre, shou'd be contain'd in a Water, they may, by repeated Evaporations, and Crystallizations, be made to shoot separate, and thus be obtain'd pure, each in the Shoots or Crystals peculiar to itself; according to what was above deliver'd, under the Article Crystallization with regard to Sea-Salt. And in this Manner therefore, Nitre may be obtain'd pure, and free from the admixture of any other Salt, which may happen to be contain'd in a Mineral Water.

42. " It will here be proper to remember, that
 " nitrous, or other saline Matters may possibly
 " be contain'd in Mineral Waters, and
 " yet not be brought to appear in a solid,
 " or true crystalline form, without some particular
 " Encheiresis, or Expedient, suited to
 " the purpose. Thus, it is a constant Practice
 " at the Salt-Petre Works, to use a fixed, alkaline
 " Salt, in order to consolidate, or
 " em-

“ embody the Nitre, and make it shoot firm,
“ strong, and regular. The Cause appears
“ to be this, that the Matters capable of af-
“ fording such firm and solid Salts, are usu-
“ ally, of themselves, too acid ; for many
“ acid Matters are little disposed to shoot,
“ and form themselves into solid, and hard
“ Crystals ; but, to fit them for this purpose,
“ require to have their prevailing acidity de-
“ stroy’d, and the whole Substance brought
“ to a neutral State, by means of fixed,
“ alkaline Salts ; or terrestrial Alkalies ; as
“ we see in the making not only of Salt-
“ Petre ; but also of Loaf-Sugar, Alum, the
“ artificial neutral Salts, &c. And these se-
“ veral Experiments, and Observations, pro-
“ perly applied, extended, and varied, may
“ afford us a Method of discovering, with
“ physical Certainty, whether Nitre be con-
“ tain’d in a Mineral Water, or not.”

III. A L U M.

43. The more essential Properties of Alum, so far as they are hitherto known, seem to be principally these ; viz. (1) Its peculiar Figure, or the Form of its Crystals, which consist of eleven plain Sides, five of them sexangular, and six quadrangular. (2) Its peculiar sharp, rough, styptick, or astringent Taste. (3) Its melting aqueous over a soft Fire, and rising in a Blister ; but, at length turning to a white, light, spongy, Substance, call’d burnt Alum. (4) Its affording when burnt, an acid Spirit, somewhat like Oil of Vitriol, by being distill’d, in a strong Fire, even without Addition. (5) This Spirit constituting Alum again, by being properly united with any fix’d, alkaline Salt. (6) Its particular Uses in striking, and fixing, certain Co-

lours, along with other Ingredients ; as we see in the Art of Dying, Leather-Dressing, the making of Red-Inks, &c. (7) Its being the only Salt, that, with suitable animals, or vegetable, Substances, will make the Black Phosphorus^m. (8) Its near affinity with Vitriol freed from the metallick part it contains. (9) Its serving, like Vitriol, in obtaining the common kinds of *Aqua fortis*, from Nitre.

44. The more satisfactory Ways of discovering whether Alum be contain'd in a Mineral Water, seem reducible to three ; viz. (1) by the Taste ; (2) by Evaporation, and treating the dry Matter ; and (3) by CrySTALLIZATION.

(1) *By the Taste.*

45. It is easy to distinguish, by the Taste, any considerable Proportion of Alum dissolved in Water ; but if the Proportion shou'd be very minute, part of the Water may be exhaled, and the Remainder tasted ; for Alum will not evaporate by being boiled in Water ; so that thus the Proportion may be greatly increased, till at length, if there be any of this Salt in the Water, it will come to be perceiv'd by the Taste. And this Case may often hold, tho' other Salts, besides Alum, should happen to be lodged in the Water ; such as *Epsom* Salt, Nitre, fix'd alkaline Salt, &c. But the Salts, or other Substances, which mix'd with Alum, in a Mineral Water, seem the most likely to confound the Taste, or prevent its perceiving the Alum, are Sea-Salt, Acid, Vitriol,

^m The black Phosphorus is a black Powder now usually made with Wheat-Flour, and Alum, mixed together, in a certain proportion, and calcined to a certain degree, till it requires the Property of taking Fire spontaneously, in the open Air, and appearing like a glowing Coal. —

styptick irony Earths, Chalk, or Limestone, corroded, and dissolved by an Acid, or otherwise ; so that tho' a Water actually contains Alum, yet the Taste shall not, with certainty, discover it : whence recourse must be had to particular Experiments, more subtle, and exquisite, than the Taste. We cannot, at present, suggest, or recollect, any satisfactory Experiment for determining, by addition to the Water, whether Alum, either alone, or mix'd with other Salts, be contained in a Mineral Water ; tho' the Plant called *ragged Robert*, is said peculiarly to turn any Water red wherein Alum is dissolved.

(2) *By Evaporation, and treating the dry Matter.*

46. When Alum is the only Salt contained in a Water, it may be easily discover'd, and render'd sensible by Evaporation ; and trying whether the dry Matter, upon examination, by the Senses, and particular Experiments, does not manifest all the known Signs of Alum. But when this Salt happens to be mixed with others ; let the dry, mix'd Mass be laid upon a hot Iron-Plate, where the Alum rising in a Blister, and separating from the rest, in the form of burnt Alum, may be afterwards dissolved in distill'd Water, and brought, by Crystallization, to the true form, and appearance, of Alum. This Method, indeed, may prove imperfect, especially when other Salts, that swell and rise in Blisters upon a hot Iron, as well as Alum, happen to be mix'd therewith ; as Borax, and the calcareous Nitre do, tho' in a somewhat different manner ; so that, in this Case, a farther Illustration, and Confirmation, must be had from the surer Method of Crystallization,

(3) *By Crystallization.*

47. Altho' a Water shou'd be truly aluminous, yet it may not be practicable, as was also observ'd under Nitre, to make the aluminous Matter crystallize, without the Assistance of a proper Expedient for the purpose. Hence, even at the Alum-Works, the Alum does not appear in its true rocky form at the first Operation, without the addition of Kelpⁿ, and putrefied Urine, whereby we are directed to use the same Expedient occasionally. And thus, if a Water shou'd contain any number of Salts, besides an aluminous one, this may, by Crystallization, properly repeated, be separated from the rest, and render'd sensible, in its own natural Form.

IV. B O R A X.

48. Borax is a Salt not hitherto allow'd to be found native in *England*, for which reason, we shall, in this place, treat more lightly of it; tho' its Natural History is of consequence in Chemistry, and Physicks; as being a Salt of a very extraordinary nature. Its discriminating Properties are chiefly these; viz. (1) Its Form, and Appearance, as brought to us from the *East-Indies*, which is that of dirty Lumps, or a coarse, saline, and particularly fetid Substance, mix'd with much unctuous, earthy, and stony Matter; and in this state it is commonly called Tincal, or Tincar. (2) Its pure, and entire, Crystals,

ⁿ Kelp is a fix'd Salt, or particular Species of Pot-ash, gain'd by burning a Weed, of the same name, which grows frequent on some Shores; and thus reducing it to solid Lumps, or Cakes, of Ashes, that run into a Liquor, somewhat like Oil of Tartar *per deliquium*, by the moisture of the Air.

when

when refined ; being octagonal Prisms, very finely cut ; tho' seldom obtain'd perfect in the ordinary way of refining it. (3) Its particular Taste, not easy to be described ; as being sweetish, sharpish, and somewhat urinous, or lixivious. (5) Its Property of soldering Metals, or making them, easily, unite, or take hold of each other ; more particularly the parts of Gold. (6) Its making an excellent Flux for Metals, and certain Ores ; and by being melted with a proper proportion of Sand, or Flint, turning, in a very short time, to a hard Glass, capable of cutting common Glass, almost like a Diamond. (7) Its extremely vitrescible nature, so as, by itself, with a moderate Heat, and in a few Minutes time, to become true, and permanent Glass.

49. The Ways of discovering whether Borax be contain'd in a Mineral Water are, principally, two ; viz. (1) by Evaporation, and (2) CrySTALLIZATION. For (1) since this Salt does not exhale by boiling in Water, (as appears in the refining of it, which requires long boiling) if any of it be dissolved in Water, it will be left behind, among the dry Substance gain'd by a total Evaporation ; which dry Substance being laid upon a hot Iron, held over a common, clear, Fire, if any part thus melts aqueous, and rises high, into a white spongy Mass ; this may be collected separate, and examin'd, by the Senses, and particular Experiments, according to the Properties above laid down, whether it be Borax, Alum, or the calcarious Nitre ; for all these rise, at first, somewhat in the same manner ; but if the Fire be continued, or raised to a proper height, the Borax soon melts a second time, and turns to Glass ; which, Alum, and the calcarious Nitre, will not do ; whereby it may be readily

The Experiments to be used. Part I.

distinguish'd from them. And this Glas has the same Properties as Borax itself, with regard to soldering, fluxing Metals, &c.

50. (2) But to gain Borax in its natural Form, and Appearance, separate from all other Salts, or foreign Mixtures, we must have recourse to Crystallization. And to obtain it in perfect, or entire, Crystals, certain Additions, Cautions, and Encheireses, are required, wherein consists the Secret of refining this Salt. Thus, in particular, it is necessary (1) to use a strong, alkaline Salt, and Lime-Water; (2) to make the Solution perfectly pure; (3) to cover this Solution, whilst it remains hot, and suffer it to cool slowly; (4) to use proper metalline Strings for the Salt to adhere to; and (5) not to open the Vessel, till the Liquor has been, for some time, cold. And thus it may be discover'd whether Borax, perfect, and imperfect, be contain'd in a Mineral Water.

V. SAL-AMMONIAC.

51. Sal-Ammoniac has the following Properties, which may sufficiently distinguish it from any other known Salt; viz. (1) Its taste is much more penetrating, and quick, than that of Sea-Salt, and somewhat urinous. (2) It renders Water intensely cold, whilst continuing to dissolve therein. (3) By Crystallization it shoots into a kind of a light, feathery, or snowy, Substance. (4) When mix'd with any fix'd, alkaline Salt, it yields a pungent; volatile Vapour, that strikes the Nostrils like Salt of Harts-horn; and if the Mixture be sublimed, a dry, volatile, alkaline Salt is thus obtain'd. (5) It has the Property of soldering, or joining Tin, and Copper together. (6) It will, by itself, with a proper

proper degree of Heat, totally sublime, unalter'd in its Nature. (7) It causes certain Mineral Matters, and even Metals, to sublime along with it. (8) It turns *Aqua fortis* into *Aqua regia*, on account of the Spirit of Sea-Salt, which it contains.

52. A knowledge of these Properties, and of the Doctrine already deliver'd, will enable us to discover whether this Salt be contain'd in a Mineral Water; viz. (1) By the Taste; especially after a large proportion of the aqueous moisture is evaporated. (2) By trying whether the Water, after a large Evaporation, will promote the union of Tin, with Brass, or Copper, in the way of soldering. (3) By exhaling the Water to a dry Remainder; and putting this Remainder to common Water, to try if it will increase the coldness thereof: and (5) By dissolving with Water, the Salts contained in the dry Remainder, and crystallizing the Solution; to try if any true Sal-Ammoniac may be thus obtain'd.

VI. *Epsom SALT*, or *Sal Catharticum amarum*.

53. Some of the principal Properties of the *Sal Catharticum amarum*, when perfectly pure, are the following; viz. (1) The form of its Crystals, which appear like small icy Plates, all of them transparent, when singly view'd against the Light; but white when lying in a heap, and view'd by Reflection: Tho' Glauber's *Sal Mirabile* also, will sometimes shoot in the like small, icy Plates, somewhat resembling fine *Sperma Ceti* in the parcel. (2) The considerable bitterness, and penetrating nature, of its Taste, whereby it seems to sink deep into the Tongue; whilst it dissolves quick in the Mouth. (3) Its dissolving totally, and readily, in its own weight

weight of common Water ; leaving the Solution coagulable into a white, and almost solid Substance, by the addition of rectified Spirit of Wine. (4) When perfectly pure, and totally separated from Sea-Salt, it neither grows hot, nor makes any Ebullition upon the addition of Oil of Vitriol. (5) Its Solution, in Water, does not turn white, or milky, with the Solution of Silver, in *Aqua fortis* ; provided the Salt be perfectly pure ; whence we may have a Test of its purity, and entire separation from Sea-Salt. (6) It has a quick, and strong, purgative Virtue ; but so likewise has that artificial Salt called *Glauber's Sal Mirabile*. (7) When mix'd with powder'd Charcoal, and set in a strong Heat, it totally exhales, and yields a copious, sulphureous Fume.

54. By these Properties we may be enabled to discover, with certainty, whether the *Sal Catharticum amarum* be contain'd in a Mineral Water ; viz. (1) By a remarkable, and particularly nauseous, penetrating Bitterness found upon tasting the Water ; especially after some considerable evaporation of its aqueous part : for this Salt will not fly off in the Evaporation ; as we know from the manner of preparing it, after long boiling, at the Salt-Works, where it is made from Sea-Water, after all the Sea-Salt is shot, when the remaining Liquor, called Bittern, by a farther Evaporation, and CrySTALLIZATION, affords the *Sal Catharticum amarum*. (2) As this Salt appears to be the most soluble, in Water, of any Salt, except Sugar, we are not by the Law of CrySTALLIZATION, to expect it shou'd appear till the other Salts are first separated, from the Mineral Waters that hold it : after which, by a fresh Evaporation, and CrySTALLIZATION, it may be gain'd in its true figure ; and be proved

to be pure, and perfect, by its having the several Properties above enumerated.

VII. *Nitrum murale*, or the calcarious Nitre.

55. This Salt is not only said to be found in Mineral Waters, but also to be procurable by powdering, and bailing, the Mortar of old Walls, and crySTALLizing the clear Solution, or Lixivium. The Properties of it, so far as hitherto known, are chiefly these; viz. (1) Its CrySTals, when perfect, are long, and slender, consisting of four, and sometimes of five, unequal, parallelogram Sides; but one of the Points of two plain Triangles, and the other of two flat Squares. (2) It is lightly bitter to the Taste, and does not readily dissolve in the Mouth; nor with the Sensation of Coolness, as true Nitre does. (3) It is a neutral Salt, or neither acid, nor alkaline, tho' very different from Salt-Petre; with which it has been confounded; as not being disposed to make Gun-powder, nor *Aqua fortis*, nor to fulminate with Charcoal in the Fire, nor to turn to a fix'd, alkaline Salt. (4) When kept upon a hot Iron-Plate, over the Fire, it rises in Blisters, and turns to a light, spongy, white Substance; which when farther urged by Heat, does not vitrify, but remains loose like Lime. The sure Way, therefore, of discovering whether this Salt be contain'd in a Mineral Water, is by Evaporation, and CrySTALLization, carried to their due length; and examining the Salts separately obtain'd, to see if any one of them answers to the Characters here laid down.

VIII. Mineral ACIDS.

56. Acids are of various kinds, or vegetable, animal, and mineral, with their respective Subdivi-

divisions^o; as Lemon Juice, Rennet, Spirit of Sulphur, or Oil of Vitriol, &c. But what we are here more particularly concerned with is the mineral Species; or such as being naturally contain'd in the Earth, may come to mix with a Mineral Water. And that something of this kind happens in certain Waters, appears to have been generally believed; as all the brisk, or spirituous, Mineral Waters are, to this day, call'd by the name of *Acidulae*. This Opinion seems to have arisen first from the Taste of these Waters; which is sharp, quick, brisk and pungent, whilst the Waters are fresh; and secondly from a Supposition, that there is one general, or universal, Acid, contain'd in the Earth; which Acid by corroding or dissolving, a suitable Earth, makes Alum, or by saturating itself with Copper, or Iron, makes the respective Vitriols of those Metals, &c.

57. Now, in order to determine whether this, or any other Acid be contain'd loose, or unmortified, in a Mineral Water; we shou'd, as in the former Cases, be previously acquainted with the Properties of Acids, as Acids. And these Properties seem reducible to the three following; viz. (1) The Taste, when rightly informed, and prepared; and the Subject properly applied, or in a sufficient degree of strength to be cognizable. Thus, tho' the Juice of Lemmons, and Spirit of Sulphur, are acid, yet they may be so largely diluted with Water, as not to be distinguishable by the exactest Taste. And that the Taste may be ill instructed, or, to speak more properly, that the Judgment may form a wrong Conclusion from the Sensation call'd Taste, is certain; because the Taste which

^o See Sect. III. § 17, and the Note thereon; and again § 27.

some call brisk, quick, or alkaline ; has by others been called tart, sour, or acid : which has been the Case in several Mineral Waters. A proper habit of Judging, or a kind of learned, and exercised, Taste, seems, therefore, requisite in this Affair. (2) The Change of Colour, which Acids, (or Liquors wherein any Acid presides) produce with certain vegetable Subjects, or artificial Preparations, is a more exquisite Way of Trial than the Taste, and discovers a much more minute proportion of an Acid than is cognizable by the direct Senses, unassisted by this Expedient. These Experiments are various ; thus, tho' a Water be but lightly acid, a few dried red Roses, or fresh Violets, will give it a fine red Colour ; as may easily be tried by adding a few drops of Spirit of Sulphur, Oil of Vitriol, &c. to distill'd Water ; and then putting in the Roses, Violets, or their respective Syrups. So, again, if a Water be acid, the addition of a little Oil of Tartar, *per deliquium*, will remarkably alter the Taste of the Water, and give it, for some small time, a degree of briskness, quickness, or pungency, upon the Tongue, which it had not before ; and take off the Acidity either totally, or in part, according to the proportion of the Oil of Tartar added. (3) The third, and most essential, or distinguishing, Property of Acids, is that of becoming neutral with Alkalies ; and thus forming a new Thing, entirely different, in its Properties, and Effects, from both. This may easily be tried in Juice of Lemmons, and Salt of Tartar, a due proportion of which makes the famous antiemetic, neutral, Mixture of *Riverius* ; in distill'd Vinegar, and Salt of Tartar, which make that extraordinary, neutral, Menstruum, and Medicine, call'd regenerated Tartar ; in Oil of Vitriol and Salt of Tartar, which
make

make the true *Tartarum Vitriolatum*, &c. And hence we are furnished with three principal, and if taken together, three sure, Ways, of determining whether a Mineral Water contains any Acid, in the form of an Acid.

58. The Particulars that may tend to invalidate, or elude, these Trials, are the Volatility, the Paucity, and the Mixture of the Acid with other Things. If the Acid of a Mineral Water should be volatile, and, at the same time, little in quantity, we may endeavour, by a careful Distillation, to separate, concentrate, or reduce it to a small bulk, wherein it may bear a large proportion to the aqueous Vehicle, that contains it; and, in this state, make our Experiments upon it; if they shou'd not be capable of discovering it in the natural Water itself. Again, if the Acid be small in quantity, but of a more fix'd nature, so as to sustain a boiling Heat, without flying off, Evaporation will easily concentrate, or bring it into a less compass, and fit it the better for our Trials. But if it shou'd be mix'd, or intimately united, with an alkaline Salt, Earth, or metallick Substance, it is not to be expected that, in this state, it shou'd, directly, manifest itself upon these Trials; as not being the Thing we here intend, or are concern'd with; as now making an Ingredient in a mix'd Body, where its own particular is destroy'd, or abolished; tho' more powerful Agents, as for instance, a violent Fire, or a proper Distillation, with suitable Additions, might here break the Connexion, and recover the Acid, as we see in the Distillation of Nitre, Sea-Salt, Alum, Vitriol, &c. where the Acid is separated from the earthy, or metallick, Matters, wherewith it was, before, intimately and strongly united.

IX. Mineral ALKALIES.

59. Alkalies are of two general kinds; earthy, and saline: we are concerned with both of them in the present Enquiry. By earthy Alkalies are meant all those earthy Matters, which of themselves scarce dissolve in pure Water; but being added in a sufficient proportion, to Acids, destroy or abolish, the Acidity thereof; and form a new Thing, of a neutral nature, that in this new, or compound, state, manifests no Signs of a prevailing Acid, or Alkali. And of this kind are Chalk, Limestone, Crab's Eyes, Oyster-Shells, Egg-Shells, &c. Thus, if common Water be acidulated with Oil of Vitriol, and a little Chalk be scraped into it; an Ebullition or Conflict, will presently arise; during which the Water has a brisk, or quick, lively taste; and at length, when the Point of Saturation is hot, all the acidity will be abolish'd, not only to the Taste, but so far, that the exactest Experiments, commonly used to determine Alkalies, and Acids, will here manifest no Signs of either. And this is a certain Characteristick, or the proper Meaning, of an Alkali.

60. Saline Alkalies are of two sorts; fix'd and volatile. How fixed Alkalies are obtainable, by Art, has been shewn above: and some of their principal Properties are the following; viz. (1) They have a fiery, or extremely acrimonious, taste; but no Odour. (2) They are caustick, and if strong, eat, or consume the Flesh, when applied thereto. (3) Being long boiled with Oil, and Water, they make Soap. (4) Of themselves, they are fix'd in the Fire; so as not to lose considerably of their weight

See Sect. III. 26.

therein.

therein. (5) They readily grow moist, and run into a Liquor, by attracting Water out of the Air. (6) Melted with Sand, or any vitrescible, earthy Matter, they make Glafs. (6) Added to Spirit of Nitre, or Spirit of Sea-Salt, they bring these Spirits back to their own Salts, respectively. (7) They turn a Solution of Sublimate in Water, yellow, or red; Syrup of Violets, or red Roses, green, &c.

61. Volatile, alkaline, Salts appear to differ but little from the fix'd; except in those Properties which depend upon their Volatility; for these also are caustick, and fiery to the Taste; but, on account of their volatility, briskly strike, and shake, the Nerves of the Nose; being spontaneously volatile, and flying away in the open Air, and in Distillation, rising sooner than Spirit of Wine. These also regenerate Nitre, and Sea-Salt, from their Spirits; tho' the Salts thus regenerated are semi-volatile, or much more volatile than the natural; being in this respect like Sal-ammoniac. And lastly, they produce the same Changes of Colour, upon Mixture, with other Things, as the fix'd.

62. Under this Head of Alkalies therefore, our Experiments must be directed to discover, whether an earthy, a fix'd, saline, or volatile, Alkali, be contain'd in a Mineral Water. And first, if a volatile Alkali shou'd be contain'd therein, we see it may be reasonably expected that this shou'd manifest itself by its Odour, by Additions, or by Distillation. The Odour of a volatile alkaline Salt, if any such be contain'd in a Water, may be perceived by immediately applying the Nostrils thereto; especially as fresh taken up from the Well; for if a very few Grains of the volatile Salt of Hartshorn, or a few Drops of the Spirit of Hartshorn, or Spirit

Sect. IV. *The Experiments to be used.*

65

of Sal-ammoniac, be mix'd with a Glafs of fair Water ; the Odour of them is very distinguishable. Again, if any volatile alkaline Salt, preside, or be a loose Ingredient in the Water, it will give Signs of itself, by changing Syrup of Violets green ; or the like Experiments by Addition : tho' these Experiments will not, of themselves, determine whether it be a fix'd or volatile alkaline Salt ; because they both act alike with regard to such Experiments : so that here the Assistance of Evaporation, or Distillation, may be used to shew whether the Salt will rise by Heat ; or remain among the dry Matter, after a total Exhalation of the aqueous Parts. And if any considerable proportion of a volatile alkaline Salt shou'd be lodged in a Water ; a gentle Distillation wou'd easily separate it from the bulk of the Water, and bring it over first, in the form of a volatile, or urinous, Spirit ; or Salt ; as we constantly find in the rectification of volatile, urinous Spirit, or Salts, with Water.

63. If a fix'd, alkaline Salt be contain'd in a Mineral Water, it is easily discoverable by the addition of such Things as are known to produce a change of Colour therewith ; tho' these will not distinguish it from a volatile alkaline Salt ; but then Evaporation is a ready Expedient, whereby a dry Matter being procured from the Water, the fix'd Salt may be dissolved, or taken up, by distill'd Water, from the rest, and thus be render'd sensible, in its own form ; at least this may be done after the other Salts, if there are any shall have been separated from it by repeated Crystallization ; for fix'd alkaline Salt, will not easily crystallize, or perhaps not at all, unless it, some way or other, unites with an Acid.

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64. If

64. If earthy Alkalies, or alkaline Earths, be contain'd in a Mineral Water, these also are easily separable from it, and render'd sensible, by Evaporation, and afterwards taking up the saline part of the dry Matter by distill'd Water; for thus all the grosser earthy Substance will be left behind. But how, different earthy Substance may be separated from each other we shall presently shew. For, we are not here concern'd with gross or metallick Earths; but those of the finer, alkaline kind; which in some degree approach to the nature of fix'd alkaline Salts; and may, therefore, in part remain permanently mix'd or dissolved in a Mineral Water, without hindring its transparency; or even pass the Filtre, along with the saline Matter. For such a kind of Earth is found to adhere, or unite, to fix'd, alkaline Salts, and may be separated from them by repeated Solutions, and Filtrations; some of this Earth, each time, remaining in the Filtre. And so much for the general Head of Salts.

II. E A R T H S.

65. By Earths we here mean all those more fix'd Parts of a Mineral Water, which remain behind after a perfect Elixation, or Separation, of the saline Matters, by means of boiling Water; whether these fix'd earthy Parts be calcarious, metallick, sandy, stony, marly, ochry, &c. And tho' possibly all the Species of Earths, when reduced to a sufficient degree of tenuity, or fineness of parts, may lodge in the Pores of Water, without hindring its transparency; yet those that have, by a proper Analysis, been found in Mineral Waters, seem chiefly reducible to three; viz. the calcarious, stony, and ochry: but if any others shou'd be contain'd in a Water,

ter, they, likewise, may be discover'd, separated, and render'd sensible. For as Earths do not evaporate by Heat, especially not by the Heat of boiling Water; whatever, of this kind, is naturally contain'd in a Water, will, after a total exhalation of the aqueous Parts, remain among the dry Matter left at the bottom: which dry Matter being once or twice boiled in distilled Water, and the Liquor each time filtred, all the more gross terrestrial Matter will thus remain behind in the Filtre. So that if only one Species of Earth be contain'd in a Mineral Water, it is thus easily obtain'd, and made to appear, in its natural form.

66. But, if two, or more, Earths are suspected in a Water; let Care be taken, from the beginning of the Evaporation, to observe, whether any terrestrial Particles concrete, or unite, into small Grains, almost like Dust, or fine Sand, upon the Surface of the Water; for these being carefully taken off, and dried, may prove a different sort of Earth, from that which falls to the bottom in the boiling; as there thus seems to be a difference in their Specifick Gravity, or fineness of Parts. So, likewise, two different Earths may be obtain'd separate, by permitting the Water to stand, for some considerable time, in a wide-mouth'd Glafs, loosely cover'd to keep out the Dust; for thus an earthy Skin will often gather on the Surface, and an ochry Substance, or metallick Earth, fall to the Bottom, or line the inside, of the Glafs.

67. Precipitation is another Method of separating the earthy Contents of a Water; as, particularly, by adding a fix'd alkaline Salt thereto; which causes the earthy Matter to fall to the Bottom; so as that it may be easily separated by the Filtre; and by being well washed,

and dried, appear in its proper form⁹; and thus be submitted to a farther Examination, by means of Lotion in pure Water; and a proper degree of Fire; whereby its simple or compound nature, may be discover'd.

68. The distinguishing Properties of a calcareous Earth are chiefly these; viz. (1) partly to dissolve, without much difficulty in the Mouth; as if it approached the Nature of fix'd, alkaline Salts; (2) to make an Effervescence with Acids, and take off their acidity; (3) to become highly sharp, corrosive, or caustick, like Lime, by being burn'd, or long detain'd in the Fire; and (4) not to melt, or vitrify, with a strong Heat.

67. Stony Earths, as found in Mineral Waters, are known, (1) by their quick falling to the bottom of the Water, in boiling; and being usually the last that remain after a perfect washing, and separation of the Salts, and other Earths, by repeated affusions of fair Water. (2) By appearing like true Sand; and melting into Glafs, in a strong Fire, with fix'd Alkali.

68. Ochry Earths are distinguishable (1) by their natural yellow, reddish, or red, Colour: (2) by growing redder after Calcination: (3) by their rough, styptick, or astringent, Taste: and (4) by their yielding some proportion of Iron, upon fusion.

69. In like manner, all other Earths, whether metallick, sulphureous, or saline, as Ores, Semimetals, Marcasites, Vitriols, &c. have their peculiar Properties; and may be discover'd or brought under the direct cognizance of the Senses, if lodged in a Mineral Water; especially by means of Lotion, Elixation, and Fusion, either alone, or with the addition of proper

⁹ See Sect. III. 26.

Fluxes, according to the Rules of Metallurgy^r.

III. S U L P H U R S.

70. Several mineral Bodies go under the general denomination of Sulphurs; as Brimstone, Orpiment, Petroleum, Bitumen, &c. but we are only concern'd with those, at present, that may lie concealed, undistinguishably to the Eye, in mineral Waters; and such are chiefly supposed to be Brimstone, and Orpiment: But, as Orpiment is not allow'd to be found native in *England*, we need not here be solicitous about it, any farther than to rectify some Mistakes which have crept abroad to its disadvantage, as if it were, what it is not, a poisonous Mineral. The true, native Opiment, or Auripigmentum, is a yellow, sulphureous, shining, or spangly, Mineral, (consisting of little flakes, or scales, like Talc) and comes to us from *Greece*, where it is dug out of certain Mountains. It is a very different Thing from all the Species of Arsenic; which are Artificial Preparations of Cobalt, a poisonous Mineral, found in *Misnia*, where the several kinds of Arsenic are prepared. Orpiment being reduced to powder, and set in the Fire, will flame, and emit a white, or yellowish Fume, yielding the odour of common Brimstone; and thus changing the surface of a polished Iron-Plate held in it, of a white, yellow, and reddish Colour; leaving a proportion of sandy Earth behind. It is used, by Painters as a Gold-Colour, and for making that called Sympathetick Ink, &c. It is sold common, at the Colour-Shops, without the suspicion of its being poisonous, any more than Antimony, or Brim-

^r See Chemical Lectures: Lect. XVII, and XVIII.

stone; and some have used it medicinally, by the way of Fumigation, and for venereal Ulcers; and others internally, for the Asthma, without finding it prejudicial. Upon the whole, Orpiment appears related to Antimony; which is also a sulphureous Mineral, that remains innocent so long as it is join'd with its Sulphur; but proves emetick, or deleterious, when separated from it: and in, like manner, not to mention other correspondencies, does Orpiment. We have been the more particular in this account, because some eminent Persons, not distinguishing betwixt Orpiment, and Arsenic, have erroneously, imagined that possibly Mineral Waters might be poisonous on account of their containing Orpiment; and again to give the Characteristicks of it, whereby it may be known, and distinguish'd; tho', as was before observed, it is not found native in *England*. But, if it were, and tho' any Mineral Water shou'd be impregnated with it, (of which no Instance has hitherto appear'd) yet the same Experiments that serve to discover Brimstone in a Mineral Water, may also serve to discover Orpiment.

71. Some of the principal Characteristicks of Sulphur, or Brimstone, are these; viz. (1) It melts readily over a soft Fire, and soon grows hard again in the Cold. (2) It is very inflammable; and burns with a livid, or blue, Flame; at the same time, diffusing, from a very small quantity, a copious, and peculiarly offensive, suffocating Vapour, or Fume. (3) Being thus burn'd under a Glass Bell, this Fume condenses into a highly acid Liquor, called *Oleum Sulphuris per Campanam*. (4) It is absolutely necessary in the making of Gunpowder; as fulminating, and having its nature entirely destroy'd by Nitre, in the Deflagration. (5) It readily unites in the
Fire,

Fire, with fix'd Alkali ; and thus makes a dusky red, or liver-colour'd, Mass ; which being dissolved in Water, and precipitated, affords an extremely fetid Odour, like that of a rotten Egg. (6) Being distill'd with Quicklime, and Sal-Ammoniac, it affords a yellow, smoking, and highly fetid Spirit : so, likewise, do those two sulphureous Minerals, Orpiment, and Antimony. (7) Its Solution in a Lixivium of fix'd Alkali, changes Silver black. (8) Being melted, and mix'd with Quick-silver, the whole presently turns to a black Mass. (9) It dissolves into a Balsom by being boiled with Oil. (10) It demetallizes Iron, applied red-hot thereto ; and has other surprizing Effects upon Metals.

72. These Properties of Sulphur may sufficiently enable us to discover, whether it be contain'd in a Mineral Water : the Ways of doing which seem reducible to two ; viz. (1) By Additions to the Water ; and (2) By treating the dry Matter left after Evaporation. But we are to observe that Sulphur, in an unmix'd state, does not easily, or perhaps, at all, dissolve in pure Water ; nor in acid Liquors ; tho' it does in such as are alkaline : whence it is chiefly to be expected in Mineral Waters of an alkaline nature. And here it may be easily discover'd by laying pieces of pure Silver in the Water to try if they will be discolour'd, or turn'd black therein ; or by adding a Solution of Silver to the Water ; to try if any blackness ensues. The Odour also, being like that of rotten Eggs, or a foul Gun-barrel, will usually discover such a Mixture of Sulphur. But (2) a more general, and satisfactory Way, is to evaporate the Water, and examine the dry Remainder, by laying part of it upon a hot Iron, to see if thus any thing melts

easily, takes Fire, or burns blue, with the peculiar Odour of fired Brimstone; or if by burning, under a Glass Bell, it will yield the *Oleum Sulphuris*. And lastly, let Spirit of Vitriol, and Water, be added, in a sufficient quantity, to a part of the dry Remainder; whereby a Precipitation of the Sulphur, if there is any, will be made; which now falling, in the form of a Powder, to the bottom, may be collected separate, sublimed into Flowers, or melted, and thus reduced to a solid lump of Brimstone, like the common.

IV. FUMES, or SPIRITS.

73. By Fumes, or Spirits, we here mean, in a general Sense, those fugitive, or volatile, Parts of a Mineral Water, which spontaneous fly off from it in the open Air; or quit the Body of the Water with a less degree of Heat than serves to raise the mere aqueous parts thereof, in Vapour; or by common distillation.

74. The Fumes, or Spirits, of this kind having never hitherto been collected separate, and examin'd, it cannot be expected that we shou'd here describe their Properties, or Effects; but as there is sufficient Evidence to shew that such Spirits, or subtile, fugitive Matters, do lodge in certain Mineral Waters, more especially in those of the brisk, alkaline and cold sort; and that they very readily desert the Body of the Water, upon standing open, or feeling a small degree of Heat; (thus leaving the Water more spiritless and vapid) our best Endeavours shou'd be used to manifest, or render sensible, to separate, collect, and examine these Spirits, in order to determine their Natures, Properties, and Uses. And the Ways of doing this seem reducible to the following ten; viz. (1) The Smell; (2) The Taste; (3) The Sight; (4) The Specifick Gravity;

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vity ; (5) Expansion ; (6) The Exhausted Receiver of the Air-Pump ; (7) Distillation ; (8) Effects upon Drinking ; (9) Additions ; and (10) Direct Collection, and Weight.

75. (1) If a Mineral Water, when a Glass of it is fresh taken up at the Well-Head, and applied near the Nostrils, shall prove to have a brisk, quick, or pungent, Odour ; but loses this Odour, after standing, for some time, in the open Air, or feeling a small degree of Heat ; it may be presumed that such a Water naturally contains what may be called a Spirit : at least it will hence be certain, that the Water, by standing open, or feeling a small degree, loses the Property which it had when fresh, of striking the olfactory Nerves, in a particular manner, so as to cause a certain Sensation denominated by that particular Odour.

76. (2) So, likewise, if a Mineral Water shou'd have a brisk pungent Taste, when fresh taken up, but lose it soon after, by standing in the open Air, or by being exposed to a moderate warmth ; this also wou'd afford a Presumption that the Water naturally contain'd a Spirit.

77. (3) Again, if a Glass of the Water, when fresh taken up, shou'd manifestly sparkle, and throw numerous Bubbles to its Surface ; or when shook in a Glass close stopp'd at the Mouth, and then immediately open'd, shou'd appear to displode, or throw off a large Mist, or Vapour, and appear to bubble, or sustain a strong internal Conflict, or commotion in its minute Parts ; but not do the same, or in a much less degree, after standing in the open Air ; it wou'd hence, at least be probable, that the Water naturally contain'd a Spirit, or subtile, active Part, which readily quits the less active, and flies off into the open Air,

78. (4) If

78. (4) If the Specifick Gravity of a Water be taken in the Well, or immediately after it is brought up in a proper Glass for the purpose; and if upon repeating the Experiment some time after the Water has stood exposed to the open Air, in the same Glass, it shou'd now prove to have a considerably greater Specifick Gravity than before, that is, if its Parts shou'd thus appear to have come closer together, or the Body of the Water to be grown denser; this also wou'd plainly intimate that the Water naturally contains a light, or volatile, Substance, which keeps its Particles at a greater distance, whilst that volatile Substance remains therein; but suffers them to come closer together after it has deserted the Water.

79. (5) If thin Glass Vials, or common Bladders, fill'd, or half fill'd, with a Mineral Water, and well secured at the Orifices; be brought before the Fire, or set in a dry hot Copper; and if other with the same Water (after having stood in the open Air) the like Glasses, and Bladders be also fill'd, or half fill'd, and secured, in the same manner; and the Bladders containing the first Water shou'd distend, or burst, sooner than those containing the second; or if the Vials containing the former, shou'd break sooner, (with the same degree of Heat) than those containing the latter; this wou'd shew that the first Water held something more elastick, spirituous, or expansive than the other. The Experiment with the Glass Vials might be made by setting them in a Copper of Water; with their Necks coming out at Holes made in the Cover; so as to prevent any danger from their bursting: for thus the Heat wou'd be applied equally, and might be exactly measured by a Thermometer, made with Oil, or Quicksilver: tho' there may be some difficulty

culty in procuring Vials, or Bladders, of the same degree of strength ; but then it may be tried whether the Mineral Water fresh taken up, will not break a Glas which cou'd not be broke by a parcel of the same Water which had stood open for some time.

80. (6) If a Glas of the Water, fresh taken up, be set under the Receiver of an Air-Pump; along with another similar and equal Glas of the same Water after it had stood exposed to the open Air, or a moderate Heat ; and if when the Air is drawn out of the Receiver, the former shou'd sparkle more, or throw up a much greater number of Bubbles than the latter ; it wou'd hence appear that the former contain'd more Air, or more of an explosive Substance, or Spirit, than the latter.

81. (7) If a Mineral Water be, at the Well-Head, directly put into a clean Glas Retort, and a Receiver be immediately luted on, with a piece of wet Bladder, tied tight with a wax'd Thread ; and now the Retort be directly placed in a *Balneum Mariæ*, or proper distilling Furnace ; if any thing like Air, or Wind, shall appear to puff thro' the Luting, or cover'd Joint, at the very beginning of the Operation, or as soon as the Retort grows moderately warm ; or if either the Retort, or Receiver, shou'd burst, without any manifest external violence, or imprudent management of the Fire ; this wou'd shew that an explosive Vapour, or Spirit, thus came from the Water. And if the same Effect did not follow upon the like Distillation of a parcel of the same Water, that had been heated before, or exposed to the open Air ; the former Conclusion wou'd be considerably verified.

82. (8) If

82. (8) If a Mineral Water, when drank fresh, at the Well-Head; shou'd have a kind of intoxicating Effect, or give a considerable degree of Alacrity, or occasion the Head-ache, a Drowiness, &c. but have no such Effects, when drank in the same quantity, by the same Persons, after having been warm'd, or after having stood, for some time open; this also may shew that the Water, when fresh, naturally contains a Spirit.

83. (9) If a Glass of any Mineral Water, fresh taken up at the Well-Head, being mix'd with a light Acid, or particularly with *Rhenish* Wine, and Sugar, shou'd make a strong Ebullition, with a large white Froath, or Foam, and discharge a visible Mist, or Vapour, to a considerable height; and during this Conflict taste extremely keen, brisk, or pungent; but do thus in a much less degree, upon the same Experiment, after having stood, for some time, open to the Air; it will hence also appear that the Water naturally contains a light, subtile, active Matter, or Spirit, which it loses by standing in the Air. So, again, if a Mineral Water shou'd when fresh, or perfect, change its Colour remarkably upon the addition of the fresh Powder of Galls, and turn with it either purple, dusky or inky; but not do this at all, after the Water has been taken up, and suffer'd to stand in the Air, for a few hours; it wou'd hence also follow, that the Water naturally contains a Spirit, in our sense of the word; and that this Spirit, is, at least in part, an actual volatile Iron, or volatile Vitriol of Iron; as no other Thing is found to have this Property.

84. (10) We come, in the last place, to an Experiment which may, if it succeed, be of itself esteem'd conclusive; but join'd with all, or some of the foregoing, will amount to a physical

sical Demonstration. The Experiment is this. Take a Vial, a Bolt-head with a proper neck, or a common Quart Bottle; and nearly fill it with a Mineral Water, at the Well-Head; have in readiness a fine, limber Bladder, well rubbed and made thoroughly supple, or pliable, by oiling it on the outside, and rubbing it betwixt the Hands, with Care to squeeze all the Air out, in which state it shou'd be carefully weighed, in an exact pair of Scales; immediately tie the neck part of this Bladder over the mouth of the Glass, with a waxed Thread, as tight as possible; then remove the Glass to a proper Furnace, or gentle Heat of Sand, or Water; where, if upon standing a while to grow warm, the Bladder appears distended, as if it were blown up; squeeze the neck part of it, to gain a Vacuity, and there again carefully pass a wax'd Thread, (which also shou'd be weigh'd beforehand, or along with the Bladder;) and now taking off the former Ligature, the Bladder may be removed, and weigh'd again, to see what additional weight it has gain'd by the Matter, or Spirit, wherewith it is distended; allowing (if weigh'd in the Air, and not *in Vacuo*) for the difference of specifick Gravity betwixt the Bladder flaccid and distended, or so full blown, and empty: And if any absolute weight be gain'd, this is the weight of the Spirit contain'd in the quantity of Water made use of; provided the Experiment was perfect. And thus the Spirit of a Mineral Water may, perhaps, not only be made sensible, as Air in a blown Bladder, to the Eye, the Touch, &c. but also, be submitted to a variety of other Experiments; in order to discover its Nature, Properties and Uses. And here it should be particularly examin'd whether the Spirit be a simple, or a compound; if a compound,

pound, how it may be resolved; how imitated; how introduced artificially, into Water; how it is naturally made, or whence it proceeds, &c.

85. We have now, in our manner, gone thro' the four general Classes, under which the principal Contents, or Ingredients, of Mineral Waters, seem to be reducible; viz. *Salts, Earths, Sulphurs* and *Spirits*; for the mere aqueous Part, which is the Vehicle, or Menstruum, of the whole, we have here no particular Regard to; as being not, strictly, an Ingredient in Mineral Waters; but a kind of general Instrument, or Agent; whose Properties, Office, and Use belongs to another Enquiry^f.

86. But it will recur, to the Imagination, that there may still, possibly, be Salts, Earths, Sulphurs, Fumes, Spirits, or many other Things, of an unknown Nature; that, either in a smaller, or larger, proportion, entring the natural Composition, or Mixture, of Mineral Waters; and such, as no Experiments, hitherto divided, can any way, discover, or render sensible. This Objection indeed, is readily suggested by the Imagination; but how far the Reason approves of it, remains to be consider'd.

87. No one tolerably acquainted with the present State of Chemistry, and Natural Philosophy, will pretend that either of them is arrived near to Perfection; or that the Ways of making a true and proper Analysis of all natural and artificial Bodies are hitherto known. On the other hand, it must be allow'd that many useful Separations, Compositions, and Recomplications of Bodies have already been made; and that many more might still be made, if Natural Philosophy, and Chemistry, were farther

^f See Chemical Lectures. Lect. V.

improved. But, with regard to Mineral Waters; when the Affair is fully examin'd; it shou'd seem that the Means of Discovering their Contents, Virtues, and Ufes, are already in the Hands of Man; and that nothing more is wanting to compleat the Work, than a prudent, scientific, and guarded Manner of using these Means; or to speak plainly, the principal Thing required is the Art of Induction. For, even the present, common, and very imperfect Chemistry supplies us with numerous Experiments, and sure Ways of discovering the Contents of Liquors; and bringing them under the direct Cognizance of the Senses; and a higher, or mere philosophical, Chemistry, as now practised by many skilful Philosophers, will here penetrate farther: So that, if Chemistry shou'd continue to improve, scarce any Analysis of this kind, wou'd, at length, prove too hard for it.

88. But, to come closer to the present Objection; What are those Things, suggested by the Imagination, to be contain'd in Mineral Waters, which no Experiments, hitherto known, can discover? Let us consider whether these Things are not Creatures of the Imagination; for so they must be allow'd, by Men, to be, if they are not discoverable by Sense, Experiment, or Reason. But if at present discoverable by Sense, or Experiment, the Objection vanishes; as depending upon a Supposition that they are not thus discoverable, at present. The Strength of the Objection, therefore, seems to be this; that the Imagination, by casting about, suggests to the Reason, that there are many Compound, or Mix'd, Bodies, which cannot, by any Experiments hitherto known, be resolved into their Constituent Parts; so as fairly to exhibit these Parts, in their simplest state, separated from each

each other, and unalter'd in their Properties; but that either, some will be so changed, or fly off, in the Operation; as not, by a re-union, to exhibit the same Subject again: Or, with regard to Mineral Waters, that these may naturally contain various Parts so subtile, so intimately united, or of a nature so utterly unknown, as not to be reached by any Artillery of Chemical Experiments; and yet that these Waters may manifest particular Virtues, or perhaps have pernicious Effects, in the Body; on account of some latent Properties in them, which no dead, languid, or incompetent Trials, made out of the Body, are subtile, or exquisite enough to discover.

89. We have endeavour'd to obviate this Objection in the Course of our Procedure; but to clear it up, more expressly, and answer it fully, with particular Instances, and Examples, it wou'd lead us too far from our purpose; and engage us deeper in Chemistry, than is, at present, necessary. Those, therefore, who require more Satisfaction, in this Point, than they can derive from the present Enquiry, (tho' we hope that will be sufficient) may please to consult the Chemical Lectures, already, more than once, refer'd to; particularly those which treat of Water, and of Synthetical, and Analytical Chemistry. We shall, however, here add, as a Supplement to the Way, already laid down, for discovering the Contents of Mineral Waters, the general Method of making an Analysis thereof; whereby whatever known, or unknown, Substances, especially those of a fix'd Nature, contain'd in a Water, may be render'd sensible, or brought to their true form and appearance; so as to be farther examin'd, or have their respective Natures and particular Properties disclosed.

S E C T. V.

A general Method of Analysing Mineral Waters.

1. L E T the first Intention be to make a natural Analysis of the Water, or to see what Changes it will spontaneously undergo, or what Parts, or Matters, it will séparate into, by standing in open, and close, Glassess. Thus, low, cylindrical, open Glassess, being fill'd with the Water at the Well, let them be directly examin'd by the Eye, the Smell, and the Taste; and again after standing for an hour, two hours; four hours, a day, or several days; to discover the sensible Alterations occasion'd by this standing, as compared with more of the Water; fresh taken up; and particularly, to find whether any visible separation of parts ensues: and if a Scum appears on the top, or a Sediment at the bottom, let them be carefully collected, and preserved, for farther Examination; observing to keep a Diary, or Register, of all the Phænomena, and the whole Procedure. And let the like Experiment, or Observation, be made in Glassess exactly closed, to discover the Changes which the Water will thus undergo, in its sensible Properties, and the Matters it thus separates, or throws off to the top, sides, or bottom of the Glassess.

2. Let the Experiment; in some of the open, cylindrical, Glassess, be prosecuted, by keeping them in a warm place, till the aqueous part is totally exhaled, and only a dry Substance left behind; which being reserved, may be compared with the dry Substance, gain'd from the same Water, by Evaporation over the Fire;

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in order to shew whether there be any remarkable difference betwixt the two dry Substances, thus procured.

3. Let the next Intention be to make an exact Chemical Analysis of the Water; and to compare it with the former. In order to this, let a certain quantity of the Water; suppose five or six pounds, Troy; be, at the Well-Head, put into a Glass Retort, with a wide Neck, and a clean Glass Receiver be immediately luted on, in an exact manner; let the Retort now be directly placed in a proper Furnace; and work'd with a very moderate Heat, so as barely to make the Water simmer; and proceed, with this degree of Heat, till all the aqueous part is come over; and only a dry Substance left at the bottom of the Retort; then, letting the Vessels cool, take away the Receiver, carefully weigh the aqueous Liquor, and keep it apart in a clean well-stopp'd Glass. And, lastly, separate the dry Matter, from the Bottom of the Retort; weigh it, whilst thoroughly dry; and put this also into a clean, dry Glass, to be kept well stopp'd.

4. At the beginning of this Operation, as soon as the Retort grows warm, let Care be taken to observe whether any volatile, or explosive, Vapour comes out at the Joint, where the Luting was applied; for if there does, this shews that there is a Spirit, or light subtile Matter, separable from the Water; tho' not capable of being thus collected: whence we are admonished to use another Method, in order to render it still more sensible, and subject it to particular Experiments; according to the Directions of the preceding Section.

5. The aqueous Part, obtain'd by the Distillation, may be examin'd with various Additions,

tions, or by applying it various Ways, in order to discover, if, in any respect, it differs from pure, distill'd, common Water; or whether it be impregnated with any saline, or mineral Particles, like those found, by the same Trials, in the natural Mineral Water. Thus, as was formerly observ'd, if it contains any Sea-Salt, it will be apt to turn white with a Solution of Silver; if any Vitriol of Iron, it will turn black with powder'd Galls; or if any Sulphur, united to an alkaline Salt, it will turn black, in time, with almost any metallick Solution. And thus its difference from common Water, or the mineral Water, that afforded it, may be assign'd by a proper variety of Experiments.

6. Let part of the dry Matter, left behind upon the Distillation, be put to, or gently boiled with, five or six times its own Weight of the purest distill'd common Water, thus freed, and before-hand proved, by particular Experiments, to be freed from any sensible known mineral Particles; for by this means all the saline part of the Matter will be taken up, by the pure Water, in the form of a Solution; which being filtred, evaporated to a proper Height, and set to crystallize, will thus give out its Salt, in the figure, or form, peculiar to itself. And tho' several Salts should be lodged in the same Solution, they may all, by repeated Evaporations, and Crystallizations, be obtained separate, (according to what has, more than once, been observed before) and examin'd, to try whether they are of a known, or unknown, kind: And tho' the kind of any Matter thus procured, should happen to be utterly unknown; yet certain chemical, and philosophical, Experiments, might be contrived to discover its Properties, and Uses; according to the common

Rules of Chemistry, and Experimental Philosophy. Thus, for Example, it is easy to determine whether any Salt, thus obtain'd, be of an acid, or alkaline Nature; by knowing the Properties of each kind, as they are above laid down*: for acid Salts turn red with Syrup of Violets, and become neutral with Alkalies, &c. And Alkaline Salts turn green with the same Syrup; become neutral with Acids; cause Sal-Ammoniac to emit a volatile, urinous, Vapour; turn a Solution of sublimate Yellow, &c.

7. But the Difficulty may seem greater to determine the neutral Species of Salts. And here we learn, from natural History, and Chemistry, that the neutral Salts dissolved, or washed out of the Bowels of the Earth, by Water, are chiefly Sea-Salt, and such as consist of a sulphureous, or vitriolick Acid, (that is, an Acid like the Acid of Brimstone, or Vitriol) and a Salt, or Earth, of an alkaline Nature. But Sea-Salt is easily discover'd by its Taste, cubical Figure in Crystallization; and the particular, white Vapour, which it largely affords upon mixing with Oil of Vitriol: The other kind of neutral Salts may be distinguish'd from all others by the Property they have of producing, or regenerating Sulphur, upon being mix'd, and melted with Salt of Tartar, and powder'd Charcoal. Thus, for instance, if two ounces of such a Salt be mix'd with an ounce of Salt of Tartar, and an ounce of powder'd Charcoal; and the Mixture be melted in a Crucible, there will thus be produced a reddish colour'd Mass, of a sulphureous, alkaline Taste, that gives a high yellow, or golden, Tincture to rectified Spirit of Wine; which Tincture will discolour Silver, or turn it

* See Sect. iv. 36—63

black;

black; and being precipitated by an Acid, affords a true *Lac Sulphuris*, that may be sublimed, and melted into Brimstone, like the common.

8. What remains behind after a perfect Elixation, or total Dissolution, of the saline Matter, by means of boiling Water, comes under the general Name of Earth; which by repeated Washings, in pure distill'd Water, and each time pouring off the Water, may happen to be separable into terrestrial Matters of different kinds; according to their different Natures, or specifick Gravities; as for Example, into Bolus Earth, or Oker, calcarious Earth, and Sand, or other Species of Earths: which if thus separable, may be examin'd by particular Additions; or by the Fire, in order to determine their kinds, and natures; as whether they are vitrescible, or convertible into Glass, by a strong Fire of Fusion; or whether they will calcine, and turn into a kind of Lime; or whether they will yield any known, or unknown, metallick Substance, or Regulus. But if the terrestrial Matter be not thus separable by washing; let the whole be examin'd, in the Fire, to try if it will here separate into parts of different kinds; as it may, if a compound, into a calcarious, a metallick, and a glassy part; being either assay'd alone, or with the Assistance of Borax, Glass of Lead, or other suitable Fluxes. And if the metallick portion should be small, so as not to be collected separate, let it be fused with the powder of pure crystalline Glass; to see if it will thus tinge the Glass of any particular colour; whereby a Conjecture may be formed of the Species of the Metal it contain'd; as whether Iron, Copper, Silver, &c. which, reduced to a Calx, are found to give

specifick, or respectively different, Colours to crystalline Glass in Fusion.

9. And after this manner we apprehend that a tolerably exact, and instructive Analysis may be made, and an useful, if not satisfactory, Account given of the Contents, and Virtues, of any Mineral Water; without entring into a more minute and circumstantial Enquiry; as directed by the Heads laid down in our second Section. And as we are not yet sufficiently prepared to give satisfactory and full Answers to all the Questions there proposed, with respect to the *Scarborough Waters*; we shall, for the present, content ourselves with giving the Analysis of these Waters, according to the Method of the present Section; referring to a future Enquiry what we shall have farther to offer upon the Subject.

10. It is but just, at the Conclusion of this first Part of our Undertaking, that we ask Pardon of the Reader, (who may be much better acquainted than ourselves, with the Ways of examining Mineral Waters,) for having dwelt so long upon the Method of doing it; and inculcated some Particulars several times over: But, to say the Truth, as the Treatises which we have read upon this Subject, appear to us far from laying the just Foundations of the Thing, or from observing a proper Form of Induction; and as many have objected to the Thing itself; on a Supposition of its being precarious, and uncertain; we found ourselves in some measure obliged, for the sake of the Many, to trespass upon the Patience of a Few; and endeavour, even by some degree of Repetition, to set this Matter in a fair Light, that every one might be able to exercise a free Judgment upon it. And in this respect, it is to be feared we have rather fallen short, than exceeded.

P A R T

P A R T II.

An Attempt to analyse the Scarborough Spaw-Waters.

S E C T. I.

Of the Scarborough Spaw-Waters in General.

1. **T**H E R E are two principal Wells of Mineral Water at *Scarborough*; which, tho' within a few Yards of each other, have yet some remarkable Differences: and that farthest from the Town being the more purgative, and that nearest the Town the more chalybeate; the former may, for distinction sake, be called the Purging, or Cathartick, and the latter the Steel, or Chalybeate, Well.

2. These Wells lie under a large Cliff, on the Sands, to the South-West of the Church, and about a Mile distant from it. They are so near the Sea, as usually to be cover'd by it at Spring-Tides: but at other Times, there is a commodious Passage to them, along the Sands, which as the Tide goes down, presently become dry, and firm.

3. The Waters, apparently, trickle into these Wells, which are Stone-Basons, by several Veins running from the Bottom of the adjacent Cliff; which chiefly consists of common Clay, Stone, Earth, and Gravel, a-top; but of Iron-stone, Alum-stone, Lime-stone, and many compound Petrefactions, below.

4. The Water of each Well appears to be clear, or pellucid; like common Water; both in the Well, and when taken up in a clean Glass; tho' not so perfectly bright, and crystalline, as the purer kinds of Rock-Water. And there are visible Marks of a yellow, or ochry, Substance deposited by each Water, on the sides of the Waste-Pipes, and the adjacent Parts of the Well, exposed to the open Air.

5. The Eye perceives no difference betwixt the Water of the Purgative, and that of the Chalybeate, Well; but to the Taste there is a manifest difference, chiefly in two respects; for the Purgative Water, especially when strong, tastes distinguishably bitterish; which the Chalybeate Water does not usually do: And again, the Chalybeate Water tastes more brisk, quick, or pungent, than the Purgative, at the Well-Head.

6. They both have that Taste denominated brackish, ferruginous, or irony; called by some also the Taste of the Mineral; and this, as distinguished from their brisk, quick, or spirituous Taste.

7. When tasted deliberately, and (if the Expression be allowable) with some degree of Skill, this quick, or spirituous Taste, is not found to be any kind of tartness, acidity, or sourness; but a certain pungent briskness; somewhat like that of sound, and ripe Malt-Liquors; or what exactly resembles the Thing, the Taste of Water first made sharp, or tart, with Spirit of Vitriol; and this Sharpness afterwards taken off by the addition of Salt of Tartar; the Mixture being tasted whilst the Conflict, or Ebullition, (here made by the Acid and Alkali) continues.

8. The

8. The Smell of both Waters, fresh taken up, is, to a quick Nose, manifestly brisk, or spirituous; and also ferruginous, or irony; that is, in common language, they smell of the Mineral; but more strongly so, after having been briskly shook in a Vial, with the Orifice close stopped, then suddenly opened, under the Nostrils.

9. When poured out of one Glass into another, or shook in the Glass wherewith they were taken up, they generate numerous Bubbles; and if shook, for a while, in a close stopp'd Vial, and the Vial be suddenly open'd before the Commotion ceases, they displode a kind of Vapour, with an audible Noise, and a perceptible Force, somewhat like what is found upon opening a Bottle of ripe Malt-Liquor.

10. In point of Coldness, they appear not to differ from each other; or from common Water, defended in the same manner, against the Sun, and the open Air.

11. The specifick Gravity of both Waters, taken at the Well-Head, is variable; not only with respect to each other, but also with respect to common Water. At sometimes, when carefully examin'd, with the same Hydrostatical Balance, their specifick Gravities are nearly equal; but at others, different: tho' both are usually somewhat heavier than common Water; but more particularly that of the Purging Well.

12. Both Waters, if set fresh under the Glass Receiver of the Air-Pump, discharge numerous Bubbles, when the Air is extracted; but the Purging Water thus appears to afford more, and larger Bubbles, than the Chalybeate, and to dart them up with a greater Velocity; tho' neither of them, by standing, for several Minutes, in *Vacuo*, and discharging their Air, seem

seem to lose of their brisk Taste, mineral Virtue, or Spirit.

13. Being drank fresh, at the Well-Head, by a healthy Person, of an ordinary Constitution, in the quantity of four or five half-Pints, in the space of an Hour, the Purging Water is found to operate quick, and give about two, or three easy Motions; at the same time, not sinking but, remarkably, raising the Spirits, or causing a degree of Chearfulness: And this the Chalybeate Water seems to do still more; tho' it purges less, and goes off chiefly by Urine.

14. Both Waters, when fresh, presently strike a dark red, or purple, with Green Tea, or Powder'd Galls; tho' the Chalybeate does this with greater celerity, and in a higher degree, than the other.

15. They both make a small Ebullition with Acids, and soon destroy the Acidity thereof. Thus, for Example, an ounce of the Purging Water will entirely take off the Acidity of a full drop of well rectified Oil of Vitriol. And if Sugar be added to these Waters, at the same time that an Acid is, and the Mixture be stirred together; it immediately creams, or flows, and sparkles, or rises in a foam; and thus the Chalybeate Water drinks very agreeably with *Rhenish* and Sugar; but the Purging Water less.

16. They both turn Syrup of Violets green; and let fall a copious white Earth, upon the addition of *Oleum Tartari per deliquium*.

17. They both curdle Milk, by being boiled therewith; and thus make an agreeable kind of Whey; having nearly the same diuretick and purgative Virtues as the Waters.

18. They do not lather, but curdle; with Soap; they serve very well in Brewing, with Malt;

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Malt; making the Liquor somewhat purgative; and they will, in some considerable degree, supply the want of Yeast, in Baking, or the making of Bread.

19. They are found to differ considerably with the Seasons of the Year, both in respect of taste, and medicinal Virtues; according as they are weaken'd by Rains; chill'd by Frost; beat upon by the Sun, &c.

20. When suffer'd to stand, in an open Glass, for some hours, or days, in the open Air, they lose of their transparency, and brisk, or spiritous, Taste; as also their faculty of striking purple with Galls; a gross earthy Substance gradually falling to the bottom; and a lighter gradually appearing, in the form of a pellicle, or icy Skin, on the top; like what we find on the top of new made Lime-water.

21. If suffer'd to stand thus, well defended from dust, or other foreign admixtures, till the aqueous Part is totally exhaled, many Grains, or small Shoots, of a true saline Substance, will appear intermix'd among a more gross, earthy Matter.

22. On the inside of the Glass Bottles, which have long served to carry these Waters from the Wells, is found an ochry Scurf, or ferruginous Substance, thus deposited by the Water, or naturally separated from it.

23. Sometimes also, by long standing in the Bottles, tho' well secured by common Corks, these Waters have been found to putrefy, and grow extremely fetid: and this the sooner if the Bottles were not new, or thoroughly cleansed from all remains of any fermented Liquors they might have before contain'd. But in Time, this Putrefaction finishes its Course, and the Water becomes sweet again.

24. The

24. The Intimations afforded by the preceding Observations, seem, with regard to the present Enquiry, to be chiefly these; viz. (1.) That the Waters of the two Wells have a considerable affinity with each other; both in respect of their Origin, sensible Qualities, Contents and Virtues; so far as these have been hitherto consider'd: the principal medicinal Differences appearing to consist in this, that the Chalybeate Water is more spirituous, less purgative, and more diuretick than the other^a.

25. (2) That, possibly, both Waters are originally no more than common Water impregnated with different proportions of certain mineral Matters capable of dissolving, or lodging, in the Pores thereof; as being taken up, or imbibed, by the Water, in its Passage over particular Beds of Minerals, till it arrives at the Wells^b.

26. (3) That these Waters are a natural Compound of (1) Air^c, (2) a mineral Spirit, or volatile Iron^d, (3) common Water^e, (4) Salts^f, (5) Oker^g, and (6) Earth^h.

27. (4) That this Compound is subject to great alterations, and liable to have its nature and texture alter'd, by various accidents; or even by long standing, or admission of the common, external Airⁱ.

28. (5) That these Waters are of a considerable alkaline, evacuating, fermentative, and putrefactive, nature^k.

29. This Information, tho', in itself, but slender, and not sufficiently verified, is yet of

^a See above, § 1—23.

^b See § 12.

^c See § 9, 12.

^d See § 5, 6, 7, 8, 9, 12, 13, 14.

^e See § 3, 4, 20, 21.

^f See § 21.

^g See § 4, 22.

^h See § 16, 20, 21.

ⁱ See § 11, 19, 20, 21, 23.

^k See § 15, 16, 13, 18,

23.

considerable use ; as it affords some knowledge of the subject, and directs a farther Enquiry into it ; by means of a more exquisite Analysis, capable of separating the Principles of the Waters, and exhibiting them in their proper forms, so as to shew in what Parts, or Ingredients, the several Properties, and Virtues of these Waters reside.

30. And as an exact chemical Analysis of the Waters is the Thing here principally intended ; it was necessary that we shou'd be previously acquainted with the natural Properties, and Effects, of the Subject : otherwise we should want a Foundation whereon to proceed ; and not be enabled to know what Changes are wrought by our future Treatment ; what Parts, or Principles, we are to expect, and endeavour to separate ; and how to know, and prove, when we have obtain'd them. Accordingly, it is a fundamental Rule, in Chemistry, first, with Care, and Exactness, to view and scan the Subject, and learn its natural Properties, Powers, and Effects ; before it is chemically examin'd, and, after the Operation is over, to compare the alter'd Subject with its original self ; whereby we come to a knowledge of what has been done, or what Alterations are produc'd, in the Process.

31. Thus, in the present Case, if the Analysis be just, we have some Reason to expect, that the Waters may be separated into Air, mineral Spirit, common Water, Salts, Oker, and Earth ; all which when separately examin'd, shall give us the physical Cause of the Properties, and Effects, naturally residing in, or producible by the Waters. And if these Principles, after having been once fairly separated, can be put together again, so as to recompose

a Water of the same Properties, and Effects, with the natural Water; there will hence be gain'd a high degree of Confirmation that the Analysis was just.

32. But the greater Advantages of our Analysis will be to shew, and distinctly separate, the natural Ingredients of the Water, without impairing their Virtues; determine what these Ingredients are; and, if possible, discover their Uses, not only to the Water, but also for the Purposes of Medicine, or other occasions of Life. Thus, for example, tho' it appears, by the foregoing Observations, that a saline Matter is contain'd in the Waters; yet we are by no means, hitherto, acquainted with its Nature, Properties and Uses. But these may appear hereafter, by means of the chemical Analysis, which we now proceed to.

EXPERIMENT I.

33. Four Pounds, *Troy* Weight, of the Purging Water, fresh taken up about the middle of *December*, 1733, being put into a very clean, and new Glass Retort; a proper Glass Receiver was immediately luted on, in the common manner, with a thin Paste of Flour and Water, spread upon brown Paper. The Receiver being placed in a Sand-Furnace, and work'd with a gentle Heat, so as just to make the Water simmer, we continued to distil, thus gently, till all the aqueous part appear'd to be come over into the Receiver, whilst a small Proportion of a dry Matter remain'd behind, at the bottom, and sides of the Retort.

34. As soon as the Retort grew warm in the Sand, numerous Bubbles appear'd to arise in the Water; and a volatile Substance seem'd, for a while, to puff faintly, like Air, thro' the luted

luted Joint; the Luting being not yet dry'd, or harden'd, by the Heat.

35. When the Glasses were grown cold again, we took them asunder; and carefully weighing the Water that was come over into the Receiver; we found it to want scarce half an ounce of the original weight of the Spaw-Water at first put into the Retort.

36. We afterwards got the dry Matter out of the Retort; and weighing this also, found it to be about two drams.

37. By this Experiment, therefore, we find the Spaw-Water visibly divided into an aqueous, or fluid Part; one that is more fix'd, and dry: whilst a more volatile Substance seems to have escaped thro' the Luting, during the Operation.

38. To render this Experiment more instructive, verify some parts thereof, and gain farther Light, as to what Passages in the Operation, we made the following upon the same kind of Water, taken up at the same time.

EXPERIMENT II.

39. Two Pounds of the Purging Water being put into a very clean, and well-tinn'd, cylindrical Vessel of Iron*; which it nearly fill'd; we set the Vessel over a soft, clear Fire; and, by gentle Simmering, evaporated the Water to driness: observing, with a clean Ivory Spatula, to prevent any considerable adhesion to the sides and bottom of the Vessel. When about an eighth part of the Water was exhale'd, numerous, small, spangly Concretions appear'd, like Dust, on the Surface of the Liquor; and,

* A Vessel of Pewter, or Iron, well tinn'd, appears, for any thing we have found to the contrary, as fit for this purpose, as one of Glass, or Porcellane.

by degrees, more and more of a grain'd matter, resembling fine Drift-Sand, fell to the bottom; where, after a total Exhalation of the aqueous part, we found a dry, powdry Substance, somewhat whiter than common powder'd Lime, and not much unlike it to the Eye.

40. This Powder weigh'd, in a tender Balance, fifty-nine Grains; tho' a single Grain might well be allow'd for waste, in getting it out of the tinn'd Vessel, to the bottom and sides whereof a minute proportion manifestly stuck: so that by this Experiment, the dry or fix'd Contents of the Water, were, at this time, to the whole Water, in its natural state, as one Dram to two Pounds Troy; that is, as 1 to 192. Hence the present, and preceding, Experiment, mutually confirm each other, with regard to the proportion of the fix'd Remainder.

41. This fix'd Remainder was also the same in both Cases, excepting that in the latter it appear'd whiter, and more powdry, on account of being frequently stirred, and kept from sticking to the bottom, by means of the Ivory Spatula. And in all other respects, the two Experiments differ'd only as Distillation, and its natural Effects, do from those of simple Evaporation.

42. It was remarkable in this Experiment, by Evaporation, repeated a second and third time, for farther satisfaction, and illustration, that tho' the Water each time employ'd, did, when first put into the Vessel, strike a deep red, or purple, with Galls; yet it ceased to do this, after having felt a certain degree of heat; or after it was advanced about half way to the state of simmering, or boiling. So that what we call the mineral Spirit, or, more properly, the volatile Iron, in the Water, seems at this time,

time, or with a scalding Heat, to quit the Body of the Water ; according to what was also intimated in the Experiment by Distillation.

43. Upon comparing the two artificial Experiments, by Distillation and Evaporation, along with the natural Exhalation of the Water, by standing open to the Air and Sun ; we shall find there is but little difference in their Effects * ; or scarce any other than what is owing to the greater length of time required in the latter ; whereby the saline part has an opportunity of shooting away from the earthy one ; whereas, in Distillation, and artificial Evaporation, they appear to be more united, or mix'd together, at last ; whilst in all the three Cases, as the aqueous part flies off, the earthy ones come closer together, and form little Concretions, like light Sand, or the icy cake on the top of the new made Lime Water ; parts of which Concretions are continually separating, and falling down to the bottom ; till all the moisture is evaporated ; and a dry Substance, or Powder, is left behind.

44. This Powder, gain'd by means of Evaporation, over a gentle Fire, and constant stirring, feels somewhat rough betwixt the Fingers ; but soon totally dissolves in the Mouth, with a remarkable bitter, saline, and roughish taste. It seems apt to relent, or run, in a moist Air ; and makes a strong Ebullition with Acids ; and powerfully destroys their Acidity. We procured a large quantity of it, as also of the aqueous part of the Purging Spaw-Water, by gentle Distillation ; in order to make Experiments therewith.

* See above, § 20, 21.

EXPERIMENT III.

45. Two drams of the dry Powder, remaining after Evaporation over a gentle Fire, being put cold to two Quarts of common distill'd Water; a large proportion of the Powder quickly appear'd to dissolve therein; whilst a less proportion of it fell undissolved to the bottom. The Solution, after being poured off clear from the Sediment, tasted like the natural Purgative Spaw-Water that had stood for some time, and lost its Spirit; and five or six half Pints of this Solution being drank, as Spaw-Water, appear'd to produce nearly the same effects; especially with regard to the purgative quality; at the same time that alacrity, or briskness of Spirits which seems peculiar to this kind of Water; and is commonly supposed owing to the mineral Spirit thereof.

46. This Experiment, therefore, intimates that the Purgative Virtue of our Water principally resides in the fix'd saline part thereof, which will not evaporate by a boiling Heat; whence we are directed to a method of procuring this saline part, and separating it from the other Principles.

EXPERIMENT IV.

47. A strong Solution being made of this dry Powder in common distill'd Water, and filter'd thro' Cap-Paper, to keep out the earthy part, and transmit the Liquor perfectly bright and transparent, we afterwards exhaled it to a proper consistence, and set it in a clean Vessel, to shoot; whereby we obtain'd a quantity of pure crystalline Salt, to which we give, by way of distinction, the name of the *first Salt*.

EXPERIMENT V.

48. The Liquor remaining after the first Crystallization, being again evaporated to a due consistence, and set to shoot, as before, affords a small proportion of another Salt, which we call the second Salt.

EXPERIMENT VI.

49. The Matter left behind in the Filtre, and in the Vessel, after the last Crystallization, being well washed with common distill'd Water, to get out all the remaining saline particles; and then carefully dried, appears in the form of a whitish Powder, which we call *Earth*.

50. And thus, by the present Analysis, the Purging *Scarborough Spaw-Water*, seems resolvable into four sensible Principles; viz. (1) *an aqueous Fluid*; (2) *a first Salt*; (3) *a second Salt*; and (4) *an Earth*; and to these may be added, as less sensible, (5) *Air*, and (6) *a mineral Spirit*: upon each of which we shall bestow a particular Examination.

S E C T. II.

Of the aqueous Part of the Purging Spaw-Water.

1. It was before observed*, that the Purging Water is, by Distillation, separable into an aqueous Part, and a dry Substance. The present Intention is to examine this aqueous Part, and to try whether it has any of the same Properties, or Virtues, as the original Water; or

* See Part II. Sect. I. § 33.

contains any real Principles, or Ingredients, thereof, more than common Water; in hopes of discovering its office, and uses, in this natural Composition.

2. To the Eye, this aqueous Part of the Spaw-Water appears not to differ, considerably, from the Spaw-Water itself, or from common Water; nor does it differ considerably from common distill'd Water to the Taste; provided the Operation was carefully performed, in clean Glass Vessels, with a moderate degree of Heat. But when attentively compared with, or tasted against, the natural Spaw-Water, fresh taken up from the Well, it is found to have nothing of the briskness, or pungency, the light Bitterness, nor mineral Flavour, of the natural Spaw-Water. And when compared with the same Spaw-Water that has stood, for some time, exposed to the open Air, it is found to want both the Bitterness, and mineral Flavour, of the latter. Nor can the Smell distinguish it from common distill'd Water; provided, as was said before, the Distillation has been carefully performed.

3. This aqueous Liquor being drank, in a considerable quantity, appears not to have the purgative, or other medicinal Virtues of the natural Spaw-Water: nor thus taken, does it seem to differ, in any respect, from common distill'd Water*.

4. So again, when examin'd by other Experiments, it discovers no considerable differences from common distill'd Water; for it neither turns red, or purple, with Galls, as the fresh Spaw-Water does; nor takes off the Acidity of Acids; nor alters the colour of Syrup of Violets; nor lets fall an Earth, upon the addition

* See above, Sect I. 13.

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of *Oleum Tartari per deliquium* ; nor turns Milk to Whey, when boiled therewith ; nor curdles, but lathers, with Soap ; nor turns remarkably milky with the Solution of Silver ; tho' some parcels of this aqueous Liquor have been found to do the latter, in a small degree. Its specifick Gravity also appears to be the same with that of common distill'd Water *.

5. Lastly, by all other kinds of Trial, in the way of Infusion, Decoction, Tincture, Elixation, &c. so far as they have been hitherto made, this aqueous Liquor appears not to differ, considerably, from common distill'd Water ; or not more than one sort of common Water does from another ; or than any pure and simple Water, that has remain'd mix'd, for some time, with the Ingredients, or Principles, of the Spaw-Water, will, after Distillation, differ from itself.

6. It therefore appears, upon the whole, that this aqueous Liquor differs, in numerous respects, from the natural Spaw-Water ; and agrees so fully with common distill'd Water, that they may very well pass for one and the same Thing ; or, in the Judgment of the Senses, for a kind of pure, *Elementary Water* ; whence, for distinction sake, we shall hereafter call this aqueous Liquor, gain'd from the Spaw-Water, by that name.

7. Hence it is manifest, that the peculiar Properties, and Virtues, of the Spaw-Water do not reside in the Elementary Water thereof, as thus separated by Distillation ; and consequently, that those Properties, and Virtues, must either remain in the dry Matter, left be-

* Compare this § with § 14, 15, 16, 17, 18, of Sect. I. Part II.

hind in the Operation; or have escaped, or been some way alter'd, or destroy'd therein.

8. That Air, and the volatile Mineral Spirit, escape in the Operation, we have already had more than a single Intimation*; and shall hereafter enquire farther about it.

9. As for the dry Remainder, we shall soon proceed to examine its Contents: and if, upon the whole, the Properties, and Virtues, of the Water can fairly be made appear, by our Analysis, without supposing any Destruction, or considerable Alteration of Parts; the Law of a physical Enquiry will necessarily exclude any such Supposition. But if to this there can be added a Recomposition of the separated Parts, so as to form the original whole again, with all its Properties; the Matter will then be out of dispute.

10. Having, therefore, found that this Elementary Water has no particular Virtue, or Property, different from common distill'd Water; and consequently, that no part of the peculiar Virtue of the Spaw-Water depends thereon, any farther than upon common distill'd Water; we proceed to examine what is the office and use of this Elementary Water to the natural Water itself.

11. And here it is plain, from the Operation and the Thing itself, that the dry Substance left behind in the Retort, or after Evaporation, was once transparently dissolved, or kept undistinguishably suspended, in this Elementary Water; even after the Air and Mineral Spirit, if any such things there were, had made their escape. Whence it appears, that this Elementary Water is, naturally, a kind of Menstruum to the

* See above, Sect. I. 34 and 42.

whole, and of use to hold the parts thereof together, in a tangible fluid Form. But as this Menstruum is gradually drawn off, by Distillation, or Exhalation, from the grosser, or more fix'd, parts; these gradually approach nearer each other, and thus forming more bulky and ponderous Concretions, fall to the bottom, or stick to the sides of the Vessel, till, at length, the Menstruum being entirely separated from them, they appear in a dry, powdery state.

12. It might lead us too far from the present Purpose to engage in a particular Enquiry into the Nature, Properties, Office and Use of Elementary Water, in general; and shew how it is naturally fitted for a Menstruum, or Vehicle, to numerous Substances, which it occasionally carries along with itself, into the Vessels or Bodies of Vegetables, Animals, and Minerals; so as to promote their Growth, maintain their Bulk, and support, refresh, and recruit the Individuals, and produce many physical Effects, particularly in the Bodies of Animals, &c. and there is the less Occasion for this Enquiry at this present, because in our Chemical Lectures, we have endeavour'd to sum up this whole Doctrine, and set in a just physical Light*. We shall, therefore, here content ourselves with observing that this Elementary Water serves as a Vehicle to the rest of the Principles of the natural Water; so as to keep them dissolved, or finely divided in their Particles, yet blended together, in an uniform, compound, state; whereby the whole is fitted to enter all the Vessels of the Body capable of admitting them: whence the Mineral Water is fitted to produce its physical and medicinal Effects.

* See Chemical Lectures, particularly Lect. V.

13. And hence we have a farther Intimation that this mineral Water may, possibly, be no more than common Water impregnated with certain mineral Substances, which it meets with, and dissolves, in its Passage over particular Beds, or Veins, of Minerals, as it runs to the Well *. But the Confirmation of this Particular depends upon discovering that the Water, somewhere in its Course, is common Water, or till it arrives at a certain Spot, where it begins to change its nature, and acquire those particular Properties, Contents, or Virtues, which we find in the natural Spaw-Water; and that any other common Water may be thus impregnated by passing over, or leisurely draining thro', the same Beds: tho' our Enquiry does not hitherto reach so far.

14. But when the whole of this Affair shall come to be thoroughly examin'd, we may perhaps be thence enabled, in some Cases, to recover a lost Spring of mineral Water. That mineral Springs have sometimes been lost, or dried up, we learn from Natural History. Now if this proceeds from hence, that the Course of the Water is changed, or that it has found, or worn itself a new Passage, so as no longer to run over the Mineral Beds whereby it was before impregnated; it may be, sometimes, proper to try whether the Water cannot be derived into its former Channel: for if it can, and the impregnating Mineral Matters are not worn out, or exhausted, there may be reason to hope that the natural Water will be thus recover'd. Or if Water be wanting near the Place, it may be expedient to cast about, and try, whether a small Rill, or slender Rivulet, of

* See above, Sect. I. 25.

common Water, cannot be led from some adjacent Parts, and directed, over the same Beds.

15. But if a mineral Water shou'd be found to have lost its Virtues, and instead of being medicinal, shou'd prove no other than common Water; this might create a Suspicion, that the Minerals which before impregnated the Water are decay'd, worn out, or exhausted: Whence we are directed, either to supply those Minerals, by throwing fresh ones, of the same sort, into the Course of the Spring; or to lead the Spring about to new Beds, of the same kind; if any such are to be found adjacent.

16. And if there be any thing solid, or well grounded, in these Intimations; we may hence see the necessity there is for making a strict search into the Course of medicinal Springs; and becoming acquainted with the Beds, or Minerals over which they run: as by this means we may not only be enabled to prolong the date of a Mineral Water, or prevent its decay; but also to restore it when lost; and to make, alter, or improve Mineral Waters at pleasure. But this is a Subject that requires more Labour than has hitherto been bestow'd upon it; and if brought to perfection, might be a noble Reward to a diligent Enquirer.

S E C T III.

Of the First Salt of the Purging Water.

1. BESIDES the Elementary Water, above examin'd, we shall find, by the present Analysis, that the Purging *Scarborough* Water contains (1) a neutral Purgative Salt; (2) an actual Sea-Salt; and (3) an alkaline Earth:
All

All three left behind, in a mix'd State, after Evaporation, under the form of a dry, powdery Substance.

2. When this dry Substance is put to a proper proportion of distill'd Water, the greater part of it readily dissolves therein; whilst a smaller part falls to the bottom; leaving the Liquor greatly altered in Taste and Virtue, according to the Observations above delivered*. And if the Liquor be now poured off clear, or be separated, by the Filtre, from the grosser part; and more distill'd Water be boiled along with what falls to the bottom, or remains in the Filtre; all the Particles that are thus capable of dissolving in distill'd Water, will be taken up thereby; and after another Filtration, and Drying, a fix'd Powder, incapable of dissolving in distill'd Water, be left behind. And thus, this first dry Substance will be separated into a part that is soluble in Water; and another that is insoluble therein; or into what the Chemists call a saline, and an earthy part: the saline part remaining dissolved in the distill'd Water, and the earthy part appearing in its own dry form.

3. But here a Difficulty may occur, or an Argument be raised against the Justness of our Analysis; "as if it had introduced a considerable Alteration, or actually produced this fix'd, earthy part; no Signs whereof appear, to the Senses, in the original Water. And the Argument may seem strengthen'd by this, that the Elementary Water, or common distill'd Water, will not now dissolve, or take up, the earthy part again, but lets it fall to the bottom; as having no affinity with it. How, therefore, cou'd this Earth

* See Sect. 1. 45—47.

" make

“ make a natural, constituent part of the
“ Water?

4. The Answer is easy, provided we recollect what was formerly observ'd*, of an earthy Matter soon manifesting itself in the Spaw-Water; both upon a natural and artificial Evaporation; whence it appears that such an earthy Matter is naturally contain'd therein; but to render it visible, requires that a part of the Elementary Water be first separated; whence earthy particles coming nearer to each other; or, in the modern Phrase, within the Spheres of each others Attraction; they thus form grosser Particles, or Clusters, so strong as not to be broke, or have the Force wherewith they attract each other, over-powered by the lesser Force wherewith they attract the Particles of Water: But if once this Cohesion is broke by long Triture, or otherwise, and the earthy Particles be render'd extreamly fine, as they are in the natural Water, then they unite more readily with the particles of the Water, than with each other; and are thus easily kept asunder. Hence, to make the Elementary Water take up this earthy Substance again, we are directed to grind it fine; and unite it intimately with a large proportion of the Elementary Water. And by this means, not only earthy, but even metallick Bodies, are made to dissolve, transparently, in Water; viz. by reducing them to small particles, and lessening their Force of Cohesion. But this Affair may be farther clear'd up, when the earthy Part of the Spaw-Water comes to be examin'd: at present, we are chiefly concern'd with the saline one.

5. Some Gallons of the filter'd saline Solution above-mention'd being evaporated to a due

* See Part II. Sect. I. 20, 21, 39, 40, 43, 44.

Consistence, and set to crySTALLize for several days, we at length obtain'd a considerable quantity of a pure Salt, in the form of transparent crystals; which were afterwards carefully dried, in a shady Place.

6. We pick'd out a few of these Crystals, which appear'd to be the most perfect, or truest shot; and examining them, by the Eye, found they consisted of two broader, and two narrower Sides; each two being equal and parallel; but the former thrice the breadth of the latter. The two broader Sides terminate, at one end of the Shoot, in a small inclined Plain, forming a sharp Ridge; and the two narrower Sides terminate pyramidal, at the other end of the Shoot, in two small Plains, inclined the contrary way from the former, and rising also to a small Ridge, or Point. Two faint pyramidal Figures appear within-side the Shoot; the one rising from the flat, the other from the pointed end, as from a Basis; and striking out their Vertices towards each other: but neither of them reaches above a third part of the whole length of the Shoot.

7. In the Parcel, or Heap, this Salt, when perfectly refined, appears white, and shining, or glossy; almost like a Parcel of white Sugar-Candy: tho' when examin'd closer, the Shoots are more flat and Tape-like than in that. When a large quantity is made at once, some of the Crystals are usually as big as the end of the little Finger; and some much larger, so as to weigh several ounces. But the greatest part is commonly small, and flat; tho' perfectly transparent; and, when examin'd with a Microscope, of the same figure as the larger.

8. This Salt has no perceptible Odour; but tastes remarkably bitter; and pretty readily dissolves

dissolves in the Mouth; at the same time seeming to penetrate deep into the Tongue; tho' without that nauseous, or disagreeable, Sensation, which is impress'd by *Epsom* Salt. It will also relent, or dissolve, by the Moisture of the Air; and is therefore best kept in a close stopp'd Glass, and in a shady place, which prevents its being turn'd white, and curdly, or having its transparency destroy'd by the Heat of the Sun.

9. When dry, it feels smooth to the Touch, and breaks, or snaps, with an audible noise, betwixt the Fingers; and when broke, does not appear fistulous, or hollow, like Nitre; but solid, and continued throughout.

10. Being laid upon a hot Iron, and held over a clear Fire, it soon melts, or appears in an aqueous form; then quickly rises, or swells, violently, and turns to a white, spongy, rarified Mass, or Calx: and tho' long detain'd in the Fire, does not change its nature, or run into Glass, like Borax; but still remains soluble in Water; and, by Crystallization, reducible again to Salt, of its own natural Figure and Properties; without any considerable loss. Whence it appears, that what the Salt loses, by this degree of Heat, is scarce any thing more than Water; as Water, alone, repairs the loss.

11. This Salt pretty readily dissolves in almost twice its own Weight of cold Water; thus making a bitter Solution, somewhat disagreeable to the Taste; but if more Water be added, the Bitterness is thereby proportionably lessen'd; so that, at length, the Liquor may be render'd as agreeable to take, bating for the Briskness, which is here wanting, as the natural Spaw-Water which afforded the Salt.

12. A strong Solution of this Salt in Water turns white, or milky, upon the addition of a few drops of the Solution of Silver in *Aqua fortis*. But whether this proceeds from the nature of the Salt, or from some small admixture of Sea-Salt therewith, our Experiments have not hitherto satisfactorily determined.

13. The other Experiments usually employ'd to discover Sea-Salt, do not manifest any considerable quantity thereof to be contain'd in this Salt; which makes no Ebullition, nor affords any perceptible Heat, Fume, or Vapour, upon the addition of Oil of Vitriol; tho' it should seem as if a quick Nose may here discover some small tendency towards the Odour of Spirit of Sea-Salt. It is also observable that the Salt it self crackles, a little, when thrown into the Fire. And hence we may be led to suspect, that a little Sea-Salt is mix'd along with it; especially, as we shall hereafter*, that it is naturally intermix'd with Sea-Salt in the Spaw-Water, and shoots in a Liquor where that Salt is certainly contain'd; whence some few Particles of Sea-Salt may easily adhere thereto. But this requires to be verified.

14. It may properly be called a neutral Salt, as it neither alters the neutral blue Colour of Syrup of Violets, nor makes any Conflict, or Ebullition, with Spirit of Vitriol, or other Acids; nor with Oil of Tartar *per deliquium*, or the Solutions of other fix'd alkaline Salts.

15. And yet this Salt curdles Milk, and turns the thinner part to Whey, by being boiled therewith; about the quantity of a Dram acting as strongly, in this manner, as near a quart of the Water. Nor does the Whey thus made with the Salt, common Water, and Milk, ap-

* See below, Sect. IV. 3; 4;

pear, in any respect, to differ considerably from that made with Milk and the natural Water. This Whey goes under the name of *Scarborough Whey*; and is found to be a soft, agreeable, purgative Liquor.

16. A quarter of an ounce of this Salt being dissolved in about a quart of common Water; the Solution, upon examination, appears not to differ from the natural Spaw-Water in any thing else but the want of the Chalybeate Spirit, a little Sea-Salt, and a due proportion of alkaline Earth. Whence we have an easy Method of making an artificial Water, resembling that of the natural Spaw, in some principal respects.

17. A quarter of an ounce of this Salt being dissolved in about six ounces of common Water, and drank as a Purge, by a Man in Health, of an ordinary Constitution; it began to operate in the space of an hour, and in half an hour after, gave four easy Motions downwards, without Gripping or Sickness; and without at all sinking the Spirits; but rather remarkably raising them; and, at the same time, proving considerably diuretick; after the manner of the natural Spaw-Water. And the like Effects have been found by several Persons, upon taking the same quantity of the Salt, or a little more, in the same manner.

18. And thus it has been found an excellent Purgative; far exceeding *Epsom Sale*, *Glauber's Salt*, *Sal Polychrestum*, *Tartarum Tartarizatum*, Cream of Tartar, Manna, &c. in costive Habits, and hypochondriacal Constitutions; as it does not, like the common Purgatives, tie up the Body, after the Operation is over; but leaves it free and open.

19. The Experience hitherto had of this Salt cannot be expected fully to manifest its Virtues;

as being a Thing not yet sufficiently brought into Practice: but Trials enough have been made to shew that it is innocent; and, in many Cases, serviceable. We leave it for Physicians to determine, whether, from the short History here given of it, the known Virtues of the Water, and the Result of the present Analysis, this Salt may not be successfully used in the Dropsy, Jaundice, Obstructions of the *Primæ Viæ* and *Viscera*, the Gravel, Stone, and other Disorders of the urinary Passages; the Iliac Passion, the Cholick, Hypochondrical and Hysterical Disorders, obstinate Intermittents, the Scurvy, Rheumatism, Gout, &c.

20. From seeing the good Effects which this Salt has had, in some of these Cases, Mr. *Culmer Cockerill*, a judicious and experienc'd Surgeon and Apothecary at *Scarborough*, has been prevailed upon to make it, for Sale, under the name of the SCARBOROUGH SALT. The Water indeed affords it but in a small Proportion; and the Operation required to make it is tedious; whence it cannot be sold, quantity for quantity, so cheap as that called *Epsom* Salt, or *Glauber's* Salt: but, as the Dose of the *Scarborough* Salt is much smaller than of those; and its Virtues, so far as hitherto appears, incomparably greater; there will, upon the whole, be no great difference in the Price, dose for dose.

21. By comparing what is here related of this Salt, with the other parts of the present Analysis, it will appear that the purgative Virtue of the *Scarborough* Spaw-Water chiefly resides in this neutral Salt: for neither the Elementary Water, the second Salt, the Earth, the Air, or Mineral Spirit, are properly purgative: whence by obtaining this Salt, we have the purgative Substance of the Water highly concentrated,

centrated, or brought into a very small Compass; so as to be at all times ready, for making, in all Places, an artificial *Scarborough Water*, or *Scarborough Whey*; that shall not differ, considerably, from the natural Water, long kept; or from the Whey made on the Spot. For, by long keeping, the Mineral Spirit is lost to the Water; and in making the Whey, it is entirely dissipated by the boiling Heat, employ'd in the Operation.

22. Another Use of this *Scarborough Salt* may be to quicken, or increase the purgative Virtue of the Water occasionally, or where it shall be judged necessary; as by this means a small quantity of the Water may soon produce the Effect expected from a larger. And in some Cases, as particularly in Dropsies, and leucophlegmetick Habits, it may seem improper to drink freely of the Water itself; especially if it does not pass readily off: whereas the prudent Use of this Salt may so far quicken the Operation, and hasten the Discharge, as to render the Water beneficial, where it might otherwise prove pernicious.

23. So again, where Purgatives are necessary, in order to prepare the Body for a Course of the Waters; perhaps a more suitable Medicine cou'd scarce be used, for this Intention, than the *Scarborough Salt*. And possibly, in many Cases, it might be an excellent Substitute for the Water itself; as particularly in hot inflammatory Disorders, Hectical Cases, Ulcers of the Lungs, &c. where the Chalybeate, Mineral Spirit, naturally abounding in the Water, might be improper.

24. We recommend it to farther Trial, to discover the medicinal Virtues and Uses of this Salt, taken not in the way of a Purgative, but

as an Alterant, in small doses ; in which quality we have some Reasons to expect it may be found eminently serviceable, in several stubborn, chronical Diseases ; being used either alone, or along with other Alterants. But it is not our Design, at present, to be large upon this Head : tho' we hope to have dropp'd some improveable Intimations about the medicinal Virtues, and Uses, of this Salt.

25. The Kind of this Salt comes next to be consider'd ; which must be determin'd by its Figure, Properties, and Effects. Its Figure, with some of these Properties and Effects, are mention'd above ; and these may be sufficient to shew that this Salt is neither Nitre, Sea-Salt, Vitriol, Borax, Sal-ammoniac, *Epsom* Salt, *Glauber's* Salt, *Sal Polychrestum*, nor Dr. *Lister's* calcarious Nitre ; but, so far as hitherto appears, a Salt *sui Generis*, and not properly referable to any known Species. But to make this fully appear, in the strict inductive Method, wou'd carry us too far from the Design of the present Analysis ; which is only to open the Subject.

26. It seems owing to the particular Nature of this Salt, that it raises the Spirits, or gives a considerable degree of Alacrity, in Purging ; which Effect, in the Water, is usually attributed to the Mineral, or Chalybeate, Spirit, naturally contained therein. But as the Salt affords no Signs, upon examination, of its containing any Mineral, or Chalybeate Spirit, nor of any way participating of Iron ; and yet has this Effect ; it may hence be reasonably suspected, that it is not the Mineral Spirit in the Water, but the neutral purgative Salt therein, that produces this extraordinary Effect.

27. It was before observ'd, that the natural purgative Water has a bitterish Taste ; and is found

found to grow more and more bitter in Evaporations, as the aqueous Part flies off, and leaves the saline Matter behind, condensed or brought closer together; whence, at last, the bitterness becomes strongest in the Salt itself. And as no bitterness is found in any other of the Principles; it hence appears that the natural bitterish Taste of the Water (as well as its purgative, and diuretick Virtue, together with the Alacrity it gives in Purging) is owing to this same Salt.

28. The Use of this Salt in the Water, may, therefore, appear to be the rendering of it naturally bitterish, stomachick, exhilarating, diuretick, purgative, deobstruent, or cleansing; whereby the whole is the better fitted to be received by the Stomach, and to promote the natural Secretions and Excretions, open Obstructions, discharge noxious Humours, and carry itself agreeably off, without burthening Nature, or causing Sickness, Griping, or Uneasiness; as the common Purgatives of the Shops usually do; but, on the contrary, operating with a degree of Pleasure; and giving additional Vigour to the Body.

29. And as this Salt must be allow'd the chief Principle, or Ingredient, in the Water, productive of these Effects, it may be accounted a principal Fruit of the present Analysis, to have found that this Salt is separable from the other Principles, and reducible to a dry, portable form, capable of preserving its Virtues unimpaired by Time, or Place: whence we are willing to hope that some Advantage may be derived to the Art of Medicine.

S E C T IV.

Of the Second Salt of the Purging Water.

1. AFTER the first Salt is fully shot out of the filtred Solution of the dry Matter, left upon the Evaporation of the Water, a saline Liquor still remains behind; which being again evaporated to a due Consistence, and set to crystallize, for several days, there at length appears a very different Salt from the former; and in a much smaller Proportion, scarce exceeding an eighteenth Part thereof: tho' some variation happens in the proportion, according to the difference of the Season, alterations of the Weather, or other Accidents.

2. This Second Salt, by the Figure of its Crystals, its Properties and Effects, upon Examination, appears, in no respect, to differ from common, or Sea-Salt; as shooting cubical, tasting muriatick, crackling in the Fire, making a strong Ebullition, growing hot, and emitting a copious, white, pungent Vapour, with Oil of Vitriol; and manifesting itself to be Sea-Salt upon all Trials.

3. When the Crystallization for the first Salt is hastily perform'd; as may happen upon boiling the Liquor too high, or setting it to shoot in too hot a Place, this second Salt is found to concrete and strike along with the other; so as to form irregular Lumps, or Clusters, having neither the Figure of the true *Scarborough* Salt, nor of Sea-Salt. But it is easy to separate them from each other, by sufficiently diluting the whole with fair Water; and setting the Solution to crystallize slowly, in a cool Place: for thus the *Scarborough* Salt will always shoot first, and leave

leave the Sea-Salt behind, dissolved in the Liquor; according to the Law of Crystallization, whereby the Salt that dissolves most copiously in Water constantly shoots last.

4. But as there is no great difference betwixt the *Scarborough* Salt and Sea-Salt, with regard to their Solubility in Water, tho' Sea-Salt dissolves somewhat more copiously therein; this occasions a difficulty in obtaining the *Scarborough* Salt perfectly free from Sea-Salt, at the first Operation. And hence, as the *Scarborough* Salt is, in the Spaw-Water itself, naturally mix'd with Sea-Salt; and manifestly shoots in a Liquor considerably impregnated therewith; and more particularly, as they are both disposed to crystallize nearly at the same time; it may well be expected that the *Scarborough* Salt will participate a little of Sea-Salt, unless Care be taken to separate them thoroughly from each other, by repeated Crystallization, with the fresh addition of pure, or distill'd Water.

5. The dry Remainder, after a total Evaporation of the aqueous part of the Mineral Water, is found to make a considerable Ebullition with Oil of Vitriol, or other strong Mineral Acid; and as Sea-Salt is found to do the same, it might hence be suspected that this Effect, in the dry Remainder, is owing to the Sea-Salt it contains. But tho' the Sea-Salt in the dry Remainder may have some share in this Effect; yet, as it will appear hereafter * that the Earth of the Spaw-Water, even when thoroughly wash'd by repeated additions of distill'd Water, to get out all the saline Particles, will still make a strong Effervescence with Oil of Vitriol; this Effect must not be wholly attributed to the Sea-Salt contain'd in the dry Matter.

* See Sect. V.

6. It wou'd be unnecessary, in this Place, to enquire particularly into the Nature, Properties and Effects of Sea-Salt, tho' this be allow'd a Principle in the *Scarborough* Spaw-Water; as these are pretty generally known, and have already been touched upon in the first Part of the present Enquiry. It may be thought more necessary to shew that it is not an adventitious Thing, or a merely accidental Part, rather than a Principle, in the Water; as might be suspected from the adjacency of the Sea to the Well. But as Sea-Salt is found in this Water in all seasons of the Year, and at all times of the Tide, and appears naturally to exist inseparably from it, in its perfect State; we rather incline to make it a Principle, or constituent Ingredient; and as such proceed to enquire of what physical Use it may be to the Water.

7. It is a known Character of Sea-Salt to be preservative, or, in some degree, preventive of Putrefaction in certain Bodies; on which account it may be suspected that this is one physical Use of it to the *Scarborough* Water. But we have not hitherto had an Opportunity of verifying, or falsifying, this Suspicion, by particular Experiments. The purging *Scarborough* Water is known, by repeated Trials, to putrefy in Time, upon Stagnation, or being close confined in Glasses; so as to become extreamly fetid, and alter in its Texture and Principles; tho' it will, at length, spontaneously, grow sweet, and potable again: But whether the Sea-Salt naturally contain'd in it, tends to preserve it sound, or prolong its perfect State, has not yet been made appear by direct Proof, or Experiment. It may here deserve to be mention'd that even Sea-Water, which is so highly impregnated with Salt, will still putrefy upon Stagnation,
or

or close Confinement, after the manner of the *Scarborough* Spaw-Water; tho' it shou'd seem that this Putrefaction is, for some time, prevented by the Salt, or its natural, found state protracted.

8. So again, it is presumed that Sea-Salt has the Power of quickening Purgatives, and acting as a *Stimulus* in the Body: but whether the *Scarborough* Salt has its purgative Virtue increased, or diminished, by a small admixture of Sea-Salt, we are not hitherto fully satisfied; but, on account of some Observations, and Experiments, incline to think that such an admixture rather lessens than heightens its purgative Virtue. A large addition of Sea-Salt certainly does so. Nor will that *Scarborough* Salt, which, in the making, remains considerably mix'd with Sea-Salt, operate near so briskly as the *Scarborough* Salt well refined, and thoroughly separated from Sea-Salt.

9. Reasons, chemical Experiments, and Observations are produced to shew that Sea-Salt passes unalter'd in its Nature and Properties thro' the Bodies of Animals; as being recoverable from the Blood, Urine, &c. in full possession of its Virtues; and reducible, by Crystallization, to its natural form. And as this Salt, in a moderate quantity, is also allow'd grateful to the Taste, or capable of giving an agreeable Relish to certain Liquids, at the same time rendering them more acceptable to the Stomach, and tending to prevent unnatural Changes, or the first Steps to Putrefaction, in the Body; it shou'd seem, that these are other physical Uses of this Salt, in the Water; as it may pass therewith thro' the several Stages of Circulation, and afterwards goes off unchanged, by all the Powers and Menstruums of the Bo-

dy. But whether these Uses are rightly assign'd, must be determin'd by farther Experience.

10. And here we desire it may be kept constantly in mind, that tho' we sometimes propose Conjectures, and offer what may appear to ourselves, probable Reasons of Things; as presuming that they are founded in Observation, or Experiment; yet we esteem them, and desire they shou'd be esteem'd by others, no more than Attempts to discover Realities, or the Facts and Laws of Nature; without at all pretending, or even hoping, to have found them, till they are verified, and demonstratively proved to be so, according to the strict Rules of physical Induction. And in this Light we desire to have the present Analysis, and the intended continuation of it, consider'd. For its impossible, in the present imperfect State of Natural and Experimental Philosophy, to render a physical Enquiry into a copious and intricate Subject, perfect at the first Attempt.

11. And hence, tho' we constantly endeavour, as much as possible, to proceed in the Inductive Method; yet no solid Judgment can be form'd of the Nature, Extent, and Use, of the *Art of Induction*, from this rude Draught, or bare Beginning of an Enquiry; to continue which, with the desired Success, and bring it to a full Period, will require much more Labour of Thought, a greater number of Experiments, and a stricter Method of Reasoning, than those who are unacquainted with the Art of Induction, or the sure Method of pursuing physical Enquiries, can readily apprehend.

12. It was thought proper to give this Intimation, before we proceed to the more difficult part of the present Enquiry; where we shall not pretend to proceed with so much Clearness, and

Cer,

Certainty, (however little that may happen to be) as we have hitherto done; and this partly thro' a want of sufficient time for making the necessary Experiments; and partly again on account of the Subtilty of Nature; which will be found greater in the following Principles of the Water, than in those hitherto examined. Whence we shall, of course, be obliged to use more Reasoning than above, in order to trace this Subtilty, and contrive Expedients to follow Nature thro' her several Doubles; so as at last, if possible, not to miss of the End proposed. And here, perhaps, the Pleasure of the Chace may be greater than that of the Capture.

S E C T. V.

Of the Earth of the Purging Water.

1. W H E N the Earth of the Purging Water is perfectly separated from all saline Particles, by repeated washing in distill'd Water, and thoroughly dried; it appears in the form of a white Powder; and sometimes amounts to about one third of the whole quantity of dry Matter, left behind after a total Evaporation of the aqueous part of the Mineral Water.

2. This Earth appears to the naked Eye, as one simple Thing, somewhat resembling pulverized Talc. And when view'd thro' a common Microscope, a large part of it appears in the form of transparent Crystals, irregularly shot; some being long and slender, others short and rough; as if they were broke; or only small portions of larger, and more regular Shoots; and others again are so small as to resemble white transparent Sand: tho' the whole
appears

appears to be more soft and downy than that : and accordingly it feels not harsh, but rather soft and silky betwixt the Fingers ; yet, it is remarkably rough, and somewhat gritty, in the Mouth, or betwixt the Teeth.

3. This Earth, tho' of itself incapable of dissolving in Water, without some previous Operation, yet being added to Syrup of Violets, slowly turns that Syrup greenish ; which gives an Intimation of a saline, alkaline disposition in this Earth. But a farther Confirmation hereof is afforded by the following Experiment.

4. Having pulverized a small Quantity of this Earth, we added an equal weight of strong Oil of Vitriol thereto ; upon which a violent Conflict, or Ebullition, immediately ensued, and the Acidity of the Oil of Vitriol, soon appear'd, by the Taste, to be greatly diminish'd, or in a manner, destroy'd. But as the Oil of Vitriol was not here sufficient, without some farther addition of Moisture, to liquify the Earth, and come into full contact therewith, on every side ; we put a suitable quantity of Water to the Mixture ; whereby the Ebullition was, in part, renew'd, and a more perfect dissolution made ; so that the Liquor being now tasted, no perceptible Acidity was found therein. Nay, it was hereby rendered so entirely neutral, that it no way alter'd the natural blue Colour of Syrup of Violets, or inclined it either to red or green.

5. And hence we have a manifest Proof, that this Earth is of a highly alkaline nature ; at least with regard to Oil of Vitriol ; the violent Acidity whereof it utterly abolishes, (like a highly alkaline, fix'd Salt ;) and this even when their quantities are equal. But whether the

the Effect holds proportionably of all other Acids, we have not yet sufficiently tried.

6. That much weaker, and more aqueous Acid, Vinegar, seems to be an Exception; as the Acidity thereof is not so readily taken off by this Earth. But the Reason may be, that Vinegar, being so small an Acid, does not operate near so strongly upon the Earth, as Oil of Vitriol does; and therefore requires a greater length of time in order to make the Dissolution; especially if the Earth be not first render'd sufficiently fine, or reduced, to impalpable or invisible particles, thereby the better to prepare, and suit it to the Action of so dilute a Menstruum.

7. And this Suspicion may receive some kind of Confirmation from hence, that the Acidity of Oil of Vitriol, Vinegar, &c. is almost instantaneously destroy'd by the Spaw-Water itself; where the alkaline Earth is so subtly divided, and perfectly dissolved; as presently to come into a full and free contact with the Acids, upon barely shaking the Mixture together: whereas, when the Earth is separated from the Water, it manifestly forms larger Concretions, Clusters, or Shoots, of a somewhat strong and close texture; so as not readily to be acted upon, especially in the more central parts, by Acids; whence a quick Solution, and intimate mixture cannot be reasonably expected.

8. But the justness, or insufficiency, of this Reasoning shou'd be made appear by particular Experiments; for otherwise, it cannot be safely relied on. And, with this View, it might be proper to reduce the Earth to such an impalpable, or subtile, State, as that it shall transparently dissolve, or remain permanently suspended in Water; so as not to appear distinguishable

guishable from it by the Eye; and thus to make the Experiment again, in order to discover if this artificial Mixture of the Earth and common Water, will not take off the Acidity of Acids, as fully and readily as the natural Spaw-Water. But this Experiment we have not hitherto had the opportunity to make; and without it shall not pretend to foretel the Success: as in the Art of Induction, 'tis a primary Rule to investigate the proper Experiments of Information, and Proof, by reasoning up to them, and then leave the Experiments themselves, when made, to determine the Fact.

9. Thus much, however, has been found, by Experiment, that a rich and strong Solution may be made of this Earth, with Oil of Vitriol, properly diluted with Water, and poured, as a Menstruum, upon a suitable proportion of the Earth, first ground fine, or reduced to an impalpable Powder; and suffering them to stand together, in a moderate Heat. And this Solution, being afterwards set to shoot, in a cool place, beautiful Crystals of *a certain neutral Salt* have been procured: the Properties, Virtues and Uses of which Salt, may, possibly, deserve to be enquired after.

10. And tho' we do not, at present, intend to prosecute this Branch of Enquiry, yet, it may not be improper here to mention a Suspicion, or Intimation, afforded us by the preceding Experiment; as it may give some Light into a difficult Part of our Subject; *viz.* the Origin, or Generation, of the First Salt of the *Scarborough* Water. For, as there appears to be some affinity betwixt this Salt, and the neutral Salt obtain'd from the Earth of the Water, by means of Oil of Vitriol; this may intimate, that, possibly, the First Salt of the *Scarborough* Water

ter is a neutral Salt produced by the natural combination of a part of this alkaline Earth, with some certain mineral Acid; whose strength, or quantity, is so limited, as not to dissolve the whole; or no more than a determinate proportion of this Earth; so as still to leave the Water considerably alkaline.

11. That the Water is considerably alkaline has appear'd above*; insomuch that an ounce thereof will quickly destroy the Acidity of a drop of strong Oil of Vitriol; but if a drop of this Oil be added to two ounces of the Water, the alkaline nature of the Water will only be destroyed in part; and the whole still remain alkaline in a less degree, or only half as alkaline as before. On the contrary, if two or three drops of Oil of Vitriol be added to a single ounce of the Water, the Water will appear to be acid, or tart, to the Tongue, and will then turn the blue colour of Syrup of Violets red.

12. Now the Cause hereof may be this, that, in the first Case, the Oil of Vitriol only lays hold of a part of the alkaline Earth contain'd in the Water, and so becomes neutralized by that part; leaving the rest in possession of its own alkaline nature; the Oil of Vitriol being unable to neutralize more of it. But, in the second Case, where a larger proportion of Oil of Vitriol is used, all the alkaline Earth appears to be neutralized; and there being not now a sufficient quantity of this Earth to take off the Acidity of the Oil of Vitriol here employ'd, part of it remains unalter'd in its nature, so as to leave the Mixture acid.

13. And hence it appears, that the alkaline nature of the Water is entirely owing to this

* See Part II. Sect. I. 15.

predominancy of the alkaline Earth therein ; or what may possibly be convertible with it, to the want of a sufficient proportion of Acid to neutralize all the alkaline Earth, and thus render the Composition neutral ; or, if the acid predominated, tart or sourish. For as a Grain of this Earth, (the quantity contain'd in about an Ounce of the Water) is, when separated from the other Principles, found, by repeated Experiments, to neutralize, or destroy the Acidity of a Grain, or Drop, of Oil of Vitriol ; and as no other Principle of the Water is found to be of an alkaline nature, it follows that the alkaline nature of the Water is owing to the predominancy of this alkaline Earth therein ; especially as the quantity of Earth separable from an Ounce of the Water, appears to have the same Effect, both in quantity and quality, upon a Grain of Oil of Vitriol, as an Ounce of the Water containing a Grain of the Earth.

14. This Point, therefore may seem, at least, tolerably verified : but it requires a deeper Search to discover whether the neutral, purgative Salt of the Water, be truly owing to the Solution of a part of the alkaline Earth, by means of a Mineral Acid. And this Particular cannot, perhaps, be fully clear'd, till it is shewn that a Mineral Acid, under some form or other, is to be found in the Water, or near the Course of the Spring, and actually mixes with the Water, or some of its Principles. For, tho' the neutral, purgative Salt, cou'd by Fire, be separated into a Mineral Acid, resembling Spirit, or Oil, of Vitriol ; and into an alkaline Earth, resembling the alkaline Earth of the Water ; as perhaps it may be ; yet this wou'd afford no certain Proof, that the natural, purgative Salt was originally form'd by a neutral Union

Union of the two. If such a method of reasoning as this should be allow'd, it would often betray us into Errors; as depending upon this precarious Foundation, that since Bodies are resolvable, by Art, into certain Parts, or Principles; therefore Nature composes Bodies by joining those Parts, or Principles, together. Indeed if Art were perfect, and cou'd exactly imitate Nature, in all Compositions, and Separations, this way of Reasoning might perhaps be just. But whilst Art remains so imperfect as it is; we are not to suppose, or imagine, but endeavour to find out the ways of Working employ'd by Nature. Nor does this, when rightly consider'd, at all clash with the Design of the present Analysis; as we do not expect to discover by it, how Nature originally form'd the Water; (which belongs to a higher Chemistry than we are here concern'd with) but to find into what distinct Parts the Water is separable, by ordinary Chemistry; so as to learn their Properties, Effects, and Uses, with a View to the Service of Man.

15. But if it shou'd once be made appear that a Mineral Acid actually mixes with the Water, in its Rise or Course; and that the neutral purgative Salt is produced upon this Mixture; then it might be a kind of philosophical Satisfaction, and an Instance of Power, to find that Art cou'd separate an apparently simple Body, into the two Parts, or Principles, whereof Nature composed it. And tho' we cou'd render it highly probable, by general Observations, Experiments and Reasoning, that there is an Acid, under different forms, to be found in the Bowels of the Earth, or near the Course of Mineral Springs; and shew how this Acid may be set loose, and enter the Body of a Water, so as

to produce the Effect now under consideration; yet not having any positive Proof, of an Acid existing near the Confines, or Current, of the *Scarborough* Spaw-Water, we purposely decline the doing thereof in this Place; as being according to the Art of Induction, rather a sophistical Thing, than a real one; or tending to amuse rather than inform.

16. There is another Intimation not to be here omitted, tho' no more than an Observation of what happens in making of the Experiments above-mentioned, with the Purging Spaw-Water and Oil of Vitriol: as it may lead us somewhat farther in the present Enquiry, and afford an occasion of searching into the Origin, or Cause, of the Briskness of the Water. The Observation is this, that upon adding two or three drops of Oil of Vitriol, to three or four ounces of the Spaw-Water, and shaking them together, a remarkable conflict ensues; and upon tasting the Water, it now has a much greater pungency, or briskness, than before. And when the Experiment is made in a Glass-Vial, and the Mixture is shook somewhat briskly, whilst the Orifice, or Mouth, of the Glass remains close stopp'd; upon opening of it again a considerable Explosion is suddenly made of a light Vapour, or subtile rarified Matter, like what issues from the Mouth of a Bottle of brisk *Pyrmont* Water, upon opening it after shaking.

17. Now, if what is above deliver'd concerning the alkaline Nature of the *Scarborough* Spaw-Water, and its Earth, be well consider'd; it shou'd seem, that this Effect is owing to the Earth of the Water, or produced by that, and the Oil of Vitriol, in the Act of Dissolution, or Intermixture: which may direct us to enquire

quire whether what is called the quick Spirit, or Briskness, of the Water, be not naturally owing to some small Conflict existing therein, betwixt a latent Acid, and the alkaline Earth of the Water.

18. Our Experiments do not hitherto enable us to pronounce, either positively, or negatively, upon this Point ; but so much seems certain, (1) that Oil of Vitriol dissolves this alkaline Earth, with a remarkable Conflict and Ebullition ; at the same time generating, or extricating, a fine, light Vapour, or subtile Matter, resembling Air, which goes off in an explosive manner: (2) that the addition of a little Oil of Vitriol to the Water, makes it much more brisk, or what is usually called spirituous ; provided so much be not added as to render the Water acid : (3) that this Conflict, whereon the artificial Briskness seems to depend, may be prolong'd, in some degree, or render'd considerably lasting, by adding the Oil of Vitriol to the Water, in a very small proportion, at due Intervals: and (4) that the like Conflict, and brisk or spirituous Taste, and explosive Vapour, may be made in common Water, for a great length of time, upon adding to it by turns, fix'd alkaline Salt, or Salt of Tartar, and Oil of Vitriol.

19. Laying, therefore these Instances together, it may, perhaps, be rationally suspected, that the brisk, or quick, and spirituous Taste of the *Scarborough* Spaw-Water is at least, in some measure, owing to a Conflict betwixt the alkaline Earth of the Water, and a latent Acid acting slowly therein ; and thus continually dissolving the Earth into a neutral Salt, so long as the Conflict lasts, or the Acid can act as an Acid : after the Cessation of which Conflict,

the Water may soon lose its Briskness, or natural intestine Motion; and thus, upon Stagnation, or thro' a want of this silent Fermentation, enter a new State, or begin to corrupt, or putrefy. But this shou'd be esteem'd no more than a Suspicion, and a Hint for farther Enquiry, till direct Experiments are brought to confirm it.

20. The Experiment here principally wanted, is one that shou'd plainly shew there is an Acid actually contain'd in the Water; and yet that this Acid is of such a Nature, or so enveloped, as not to act powerfully, all at once, upon the alkaline Earth; as naked Oil of Vitriol does, when added to the Water; but slowly, silently, and by degrees; thus, in length of time, converting more and more of the alkaline Earth into neutral Salt; and at last ceasing to operate; either because its quantity, or strength, is overpower'd by the alkaline Earth; or because it has converted the whole of that Earth into Salt.

21. It was before shewn that Sea-Salt is naturally contain'd in this Water; and it is certain that Sea-Salt contains an Acid; or, to speak more strictly, that an Acid, called the Spirit of Sea-Salt, may, by Art, be readily separated from it; for instance, barely by the addition of Oil of Vitriol. Now, if, by any natural Means, the Acid of the Sea-Salt, can be separated in the Water, and slowly brought in contact with the alkaline Earth, a neutral purgative Salt may possibly thence arise, somewhat in the same manner as we see in the making of *Glauber's Sal Mirabile*; where the Oil of Vitriol gradually laying hold of the Earth of Sea-Salt, as the Spirit distils off; at length forms

forms a Cake of neutral Salt at the bottom of the Retort.

22. But before this Reasoning can have any weight as Evidence of the Fact, there are several Particulars to be consider'd, and several Experiments to be made; thus, for example, as there appears to be but a small proportion of Sea-Salt naturally contain'd in the Water; how can this afford a sufficient quantity of Acid, to produce a so much larger quantity of a neutral purgative Salt? And were the quantity sufficient, yet by what physical Means is the Acid separable from Sea-Salt in the Water? And tho' it were to be separated, will it certainly act upon the alkaline Earth; so as to produce a neutral, purgative Salt, like that of the *Scarborough* Water? Is this purgative Salt constantly upon the Increase, and the Sea-Salt upon the Decrease, so long as the Water continues in its brisk, or spirituous State, &c?

23. These Queries are not here propos'd as if we cou'd give satisfactory Answers to them; but with a View to intimate that there may, possibly, be a latent Acid, or the Matter of an Acid, contain'd in the Water; and that this Acid may possibly be slowly separated by the ordinary Operations of Nature, so as to answer particular purposes in the Water; without undertaking, at present, to shew what this latent Acid is, where it resides, or how it acts. That Acids may be latent in Liquors, till they find an opportunity of manifesting themselves, we learn from many Instances; as in Wine, Milk, Honey, Sugar, &c. wherein, at first, the Senses, nor even the more exquisite Experiments, can discover no Acidity; yet Wine by bare standing throws off an acid Salt, or Tartar, Milk turns
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sour, and Honey and Sugar, with Water and Warmth turn to Vinegar.

24. But we have still a farther View in this Procedure; for, having undertaken to shew something of the Art of Induction, or the Method of Enquiring into physical Subjects, but particularly into Mineral Waters; we wou'd not willingly omit any Opportunity of illustrating this Art by Examples; and therefore chuse, on all suitable Occasions, to point out, as much as possible, the various Steps of Enquiry, and the several Workings of the Mind, necessary to the forming of a just Induction; being persuaded that if this Method were steadily pursued, in a suitable variety of Subjects, more and greater Discoveries might be made in Nature, within the Compass of a few Years, than by the common Method, in many.

25. We fear to have dwelt too long upon this dry Article of Earth; as it may seem to those who do not estimate Things philosophically; and shall therefore endeavour to dispatch, in a conciser manner, what we have for the present, further to say of it. And thus much seems to be fairly discover'd of it, that it is of a highly alkaline nature, and convertible into a neutral Salt with suitable Acids: whence it might be proper to enquire whether this Earth may not have some considerable Use in Medicine; and, on many Occasions supply the place of other less powerful terrestrial Alkalies, or those commonly called the Testaceous Powders. But, having not yet given it alone, to answer any curative Intention, we can only recommend it as a Thing worthy of Trial, from its obvious Properties and Effects; and particularly in certain Diseases of Children, which appear to be chiefly seated in the first Passages, and are judg-
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ed to proceed from a predominant Acidity in the Bowels and Juices.

26. It may, likewise, deserve a careful Examination, whether some considerable Effects of the *Scarborough* Spaw-Water, upon drinking it, are not owing to this alkaline Earth; as particularly, it's being found curative in Hecticks, serviceable in Consumptions, supposed Ulcers of the Lungs, Kidneys, &c. after the Mineral Spirit, or chalybeate Virtue, has been discharged, by open standing, or by a moderate Heat; provided the Water be drank, in such small doses, and at such intervals, as to prove rather alterative than purgative: which, possibly, is no inconsiderable Secret in the administration of this Water.

27. Again, we recommend to farther Enquiry, whether the great safety, and advantage, wherewith the *Scarborough* Spaw-Water is freely drank the next day after the plentiful, or immoderate, Use of Wine, or other spirituous Liquors, be not, in some measure, owing to this alkaline Earth; chiefly on account of its correcting the Acid which such Liquors are apt to leave behind in the Stomach, so as to occasion Nausea's, Sicknefs, the Heart-burn, Head-ach, &c. which are found to be soon remedied upon drinking the *Scarborough* Water.

28. If this alkaline Earth, given by itself, shall, upon competent Experience, be found to have considerable Virtues; it may then be proper to try whether the Water itself cannot be heighten'd in those Virtues, or render'd more efficacious in the Cure of certain Diseases, by a prudent addition or use of more of this Earth. And this should seem to be the more necessary in such Distempers as are attended with loss of Substance to the Vessels, or Organs, of the

Body, great Wasting, and inward Decays, &c.

29. If, on the contrary, there are any Distempers, in themselves of an alkaline nature, where this alkaline Earth may be supposed improper; it is easy, according to what was above observed, by the prudent addition of a suitable Acid, to render this Earth neutral; and thus to accommodate the Water to the nature of the Distemper, even tho' Acids themselves were required.

30. An Objection, indeed, has been made to certain Mineral Waters, on account of their containing a large proportion of Earthy Matter; as if this were insoluble in the Body, and tended to generate certain Diseases, rather than cure them; as particularly the Gout, Stone, Asthma, &c. and a very plausible Argument might be formed upon this Supposition, without consulting Experience. But, as we hope to have shewn, in the Course of this little Enquiry, that no such Reasoning is of force, without Experiment; the Objection, so long as it rests in Reasoning, has no Right to an Answer.

31. All Waters, more or less, appear to contain an earthy Substance; and those, of the common kind, are allow'd the purest and wholesomest that contain the least; especially if it be of the hard, crusty, petrescent sort; which, tho' it might, perhaps, sometimes contribute to the generation of a stony, or tartareous, indigestible Matter in the Body; yet it should seem, that no valid Argument can hence be raised against a soft alkaline Earth, in Mineral Waters; or an Earth easily convertible into a neutral Salt (perhaps by the Acid naturally lodged in the Stomach;) and capable afterwards of acting as a dissolved innocent Salt, in the Body.

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And tho' it shou'd remain unalter'd therein; are not the solid Parts of Animals and Vegetables, formed of a real Earth? This Article of Enquiry may deserve to be prosecuted in the inductive Manner. But Medicine is hitherto little acquainted with the *Art of Induction*.

32. From the preceding Account of the Earth of the *Scarborough* Purging-Water, it may be suspected, that the Use of it in the Water is to render the whole properly alkaline; and fit for the Cure of such Distempers as require the assistance of Edulurants, or Sweeteners, as they are called; such, in particular, as the acid Scurvy, sharp Humours, ill Habits of Body, unsound Viscera, old Ulcers, Diseases consequent upon hard Drinking, many of the Diseases of Children; and in most Cases where a fine, or subtilized alkaline Earth is proper.

33. We do not, without farther Examination, pretend to determine the specifick nature of this Earth; or to say whether it be an Earth *sui Generis*, or referable to any known kind. In some of its sensible Properties, it seems to agree with Talc. But before its true Nature can be assign'd, its entire Figure, or Shoot, if it has any, should be found; the Salts it makes with different Acids examin'd; and the colour it gives to crySTALLINE GlASS in Fusion; its Phænomena upon long Calcination; application to the Magnet, &c. noted. But these Experiments remain to be made; at least, in a more full and exact manner than we have hitherto made them.

34. But, besides this alkaline Earth, there appears to be another, separable from the Water, upon long standing, in the form of a Bolus Earth; containing, or affording by Fusion, a small proportion of Iron. But as this seems to

be no Principle of the Water, in its natural, sound, or perfect State, and, not to exist, under that form therein, till the Water has undergone some considerable alteration, or begun to putrefy; we shall take no farther notice of it, in this place; as our present Design extends only to the Analysis of the Water in its sound, or perfect state; leaving its putrefied state, and its recovery from thence, to be examin'd hereafter.

35. For the same Reason, we here make no mention of a Sulphur, of actual Brimstone, in the Water; as this is not discoverable therein till after Putrefaction; which, possibly, may be found an Operation that generates, produces, or extricates Sulphur in the Water, somewhat after the same manner as inflammable Spirit is generated, or produced, by vinous Fermentation.

36. There is still another kind of Earthy Substance, which appears separable from the Water, in its entire, or perfect state, by an artificial Contrivance to concentrate the Mineral Spirit, or Irony Principle thereof, and perhaps reduce it from a volatile to a fix'd state; by the addition of powder'd Galls, or other astringent vegetable Substances, fit for the making of common Writing Ink, with Copperas, or the Vitriol of Iron. But this Irony Principle will come more naturally to be examin'd, under the Head of Mineral Spirit, to which it may properly belong; as appearing to exist under that form, in the natural, sound and perfect Water. We, therefore, now proceed to the two less sensible Principles of the Purging Water; viz. Air and Mineral Spirit.

SECT.

S E C T VI.

Of the Air of the Purging Water.

1. AIR seems to be more or less, contain'd in all Water; but particularly the fresh *Scarborough* Spaw-Water abounds with it; allowing that subtile explosive Matter to be Air, which is plentifully discharged by this Water, (upon standing, for some time, under the exhausted Receiver of the Air-Pump) in the form of those generally called Air-Bubbles in Liquors; which kind of Bubbles are large in the Purging Water, and darted with considerable force from the bottom part of the containing Glass, to the Surface; whilst the Receiver remains exhausted by working the Pump.

2. So, likewise if a Glass-Vial be filled with fresh *Scarborough* Spaw-Water, and the Mouth of the Vial be inverted into an open cylindrical Glass, nearly filled with the same Water; the lower Glass being set in a Water Heat, the Water whereof does not reach up to the Vial; the Warmth will occasion the Air in the Spaw-Water to rise up into what is now the upper part of the Vial, and there collect into a large Bubble; whereby the proportion of Air contain'd in a certain quantity of the Spaw-Water may be nearly determin'd. But we attempted to make the Experiment, more satisfactorily without Heat, in the following manner.

3. We filled a common Quart Bottle with the Purging Water at the Well-Head; then immediately tied over the Neck of the Bottle a limber Bladder, which had first been well oiled on the outside, to render it more pliable, and fill

fill up the Pores; so as, if possible by this means, to prevent any escape, or avolation of a subtile Matter thro' the sides of the Bladder; taking Care also first to squeeze out all the Air it might contain, by drawing it, like a string, several times thro' the Hand. Having thus fix'd the Neck of the Bladder tight to the Neck of the Bottle; the Effect was, that, in a few Minutes, without any application of Heat, the Bladder swell'd, and appear'd as if it were near a quarter full of Air. And, in this state it remain'd for several days; during which we frequently compress'd the Bladder, beginning at the Neck of the Bottle, and twisted it upwards; so as to collect all the subtile Matter at the upper Part of the Bladder; where, at those times, it constantly appear'd to swell the Bladder into a round Ball, the size of an ordinary Orange; and had it been Water, wou'd have measured about a quarter of a Pint.

4. Hence it shou'd seem that a considerable proportion of a dry, subtile, Elastick Fluid is naturally contain'd, after a loose manner, in the Water; so as to be separable from it spontaneously; without any external Heat, more than that of the common Air, or Atmosphere; and that it even flies off from the Water with some degree of force; as being able to distend a Bladder whose sides are compress'd, or squeezed together, by the weight of the Atmosphere. In order to discover what this subtile Matter, thus collected in the Bladder, was; we prosecuted the Experiment somewhat farther.

5. After the Bottle and Bladder had continued for above a Week, in the state already described; by twisting the under part of the Bladder we squeezed the subtile Fluid, to the upper end, and there tied it up in the form of a round Ball;

Ball; then taking off the lower String which fasten'd the Bladder to the Neck of the Bottle; we removed the Bladder, with its Contents. And now pouring some of the Water out of the Bottle, we added pulverized Galls thereto; but found it afford no purple Colour: which gave us some little Expectation of having obtain'd the Mineral Spirit in the Bladder; tho' we suspected, the subtile Matter here rose too soon, or with too small a degree of Heat, to be the Mineral Spirit, which appears to continue for some time in the Water, upon standing; and does not entirely quit it over the Fire, without a scalding Heat.

6. However, for farther Satisfaction, after having examin'd the Bladder, and found it's Contents elastick; we plunged it's Neck into common Water, where a little powder'd Galls had first been put; then taking away the Ligature, we gently squeezed the Bladder downwards, towards the Water, to make it discharge its Contents therein; not forgetting to keep the Water stirring, that it might, if possible, imbibe the subtile Matter: and thus having, by slow degrees, render'd the Bladder flaccid, or brought its sides close together, we took its Neck out of the Water; but no red or purple Colour ensued.

7. This Experiment, consider'd in all its Circumstances, opens a large Field for farther Enquiry; particularly with regard to the Mineral Spirit, which here seems to have escaped insensibly, and left us, as it were at Fault; being neither found in the Water nor Bladder: which affords us an Instance of the great Subtilty of Nature; and may put us upon inventing more suitable Expedients to detain, collect, or fix this Mineral Spirit, or bring it under the more immediate

mediate cognizance of the Senses. But this belongs to the following Section; at present we are chiefly concerned with the Air of the Water; which seems to have been separated, collected, and render'd palpable, by the preceding Experiment.

8. But this Experiment itself requires to be farther verified, varied, and extended; so as to shew whether the subtile Matter here collected be true and permanent Air; whether it be unmix'd with any thing else; whether it has a greater Elasticity than common Air; what is it's absolute, and what it's specifick Gravity; whether it be tinged with the Mineral Spirit; how it naturally comes into the Water; what Proportion it bears thereto; whether it be accidental, or a true Principle therein; whether it will not in time, be absorbed by it's own Water again, &c. for this and much more must be done, before we can have an Inductive History of this Ingredient of the Water. But the slender Enquiry we have hitherto made, falls short in these Particulars.

9. But, perhaps, the following Experiments added to those already produced, may enable us to make a just Distinction betwixt the Air and Mineral Spirit of the Water, and incline us to allow them both as Principles. For, having filled an open cylindrical Glass, with the fresh purgative Water, and put it under the Receiver of an Air-Pump, then exhausting the Air, in the usual manner, and keeping the Water in this State till it appear'd to emit no more Air-Bubbles. We afterwards took the Water out, and put a little Powder of Galls there-to; upon which the Water appear'd to change its colour, or turn purple, as strongly as before it was set under the Receiver. Whence it shou'd seem that the Mineral Spirit, or chalybeate Property

perty of the Water, did not escape along with the Air-Bubbles here discharged by the Water; and consequently that these Air-Bubbles and the Mineral Spirit are two distinct Things, separable from each other; tho' naturally existing in the Water together.

10. And this Experiment, and Conclusion, may seem somewhat farther confirm'd from hence, that tho' the Chalybeate Mineral Water appears, by the common Experiment with Galls, to contain more of the Mineral Spirit than the purging Water does; yet by the Experiment of the Air-Pump, the Purging Water discharges more Air-Bubbles than the other; and accordingly, having fill'd a Quart Bottle with the Chalybeate Water, and fitted a Bladder to it, at the same time, and in the same manner, as above described*; the Ball of subtile Matter here collected in the Bladder, was not above one fourth part so large as in the other. This Experiment, therefore, if found constant, intimates that the Air and Mineral Spirit are two Things in the Water; and that where one is largely contain'd the other may be less.

11. And it is chiefly on account of this large proportion of Air, naturally contain'd in the Purging Water, that we rather incline to make it a Principle; for if no more Air cou'd be here discover'd than in common Water, or the ordinary Sorts of purging Mineral Waters, such as those of *Epsom*, *Dulwich*, *Aston*, &c. (which are found to contain but little Air, or no more than almost any other aqueous Liquors) there cou'd be no just Foundation for making Air a Principle, or a more than ordinary Ingredient, in the purging *Scarborough* Spaw-Water.

* § 3.
12. Having,

12. Having, therefore, discover'd a Method of separating this Air from the Water, and collecting it, in a palpable form, distinct from the other Principles; we shou'd next proceed to examine its Properties and Effects; with a View to discover, whether it differs from the common, or atmospherical Air: but as we have hitherto made no considerable Progress in this part of the Enquiry; all that can fairly be said of it at present, is, that it appears to approach the Nature and Properties of common Air; and as such, we shall here consider its Use in the Water; referring, for farther Satisfaction, to future Trials, and our *Chemical Lectures*, especially the two that treat of *Water* and *Air*.

13. As, according to the Observations and Experiments above delivered, the Air appears to be under a State of compressure in the Water; so as readily to escape, upon the first Opportunity offer'd; hence this Air shou'd seem to exert a kind of struggling Motion in the Water; so as to keep the Particles thereof at a greater distance from each other, or render the whole specifically lighter, than after this Air has deserted it. And accordingly, the specifick Gravity of the Water appears to be considerably increased upon the Avolation of the Air; tho' the Mineral Spirit, perhaps, may still remain behind. But this also requires to be farther verified; as it might easily be by means of the Experiment made with a Bladder, tied over a very slender long-neck'd Glass, fill'd with the fresh Water; and finding the Surface thereof fall lower, when the Air is separated and collected in the Bladder; and presently removed from the Glass.

14. If this shou'd prove the Case, we might hence, perhaps, infer that one Use of the Air

to the Water, is to rarify it, or render it more light and subtile, whilst detain'd, under its own form, therein. And this may seem a little confirm'd, from hence, that the Water, drank fresh at the Well, whilst the Air remains in it, appears to sit lighter upon the Stomach, and to fly up into the Head, and distend the Vessels, more than when it is drank after standing open for some time; whereby the Air appears to escape.

15. And thus, as Air is elastick, or has the Property of rarifying, or distending itself every way, with Heat; it shou'd seem that the natural Heat of the Body, by rarifying the Air contain'd in the Water, when drank fresh; widens the Passages; and thus renders the Water more subtile and penetrating; or enables it to enter such fine Vessels, as might not otherwise so easily admit it: whence the Water may be assisted in its Operation, and render'd more efficacious in opening Obstructions, and cleansing the finer Canals of the Body.

16. And if this Use of the Air in the Water be rightly assign'd; we have hence one Reason of the difference found betwixt drinking the Water fresh at the Well-Head, and after it has stood open for some time, so as to discharge it's Air. For tho' the Water retains it's purgative Virtue after the Air is gone; yet it seems not now to pass so far into the Habit of the Body, and produce all the same Effects, as when it is drank fresh, and replete with its natural Air and Spirit. Whence to have the full Effect and Benefit of the Water, it seems most advisable to drink it fresh at the Well-Head: tho' in some Cases, it is, doubtless, best to drink it after both the Air and Mineral Spirit are discharged;

charg'd; as particularly where the Vessels, or *Viscera*, are weak or unsound.

17. Another Use of the Air in the Water may be, to give it that Quickness, or Briskness of Taste, for which it is remarkable, when fresh; tho' this Effect, upon being fully enquired into, may perhaps be found to depend, not so properly upon the Air, as upon a certain physical Action in the Water, whereby the Air itself is produced. And here it may deserve to be tried, whether the artificial introduction of Air into common Water, will render the Water properly brisk, or pungent; like the *Pymont* or *Scarborough* Spaw-Water. For, if not, it may hence be suspected that Air, as Air, does not give Briskness to these Waters. And, indeed, there seems room to suspect, that Air, in this Case, is rather a Concomitant than a Cause; or that the Air is here generated, by the Action, or Operation, which is the true Cause of Briskness; as we see upon adding Spirit of Vitriol, or other Acids, to common Water, first made alkaline with Salt of Tartar, or the like*.

18. In the mean time, it may be suspected that the Air, or subtile Matter, whether naturally existing, or generated, in the Water, shou'd have some share in producing this Effect; as it may prove the Instrument, or secondary Cause, of an intestine Motion in the particles of the Water, by struggling among them, and endeavouring to escape; whence the Particles of the Water, thus agitated, may be more briskly impressed upon the Tongue, or made, in part, to fly off, and strike the olfactory Nerves. But this remains to be confirmed, or rejected, by particular Experiments: and we

* See above, Sect. V. 16—21.

here propose it only as a distinction that took its rise from Experiment, without asserting it to be just.

19. It must also be left for future Experiments to determine, whether a part of the Air, still remaining in the Water, after the Air-Pump has acted upon it, be not a kind of Vehicle to the Mineral Spirit, or light Irony Substance; which afterwards gradually makes its escape, in the open Air, or all at once upon feeling a suitable degree of Heat. The Air-Pump is not found to extract all the Air contained even in common Water; nor does the Mineral Spirit, or Irony Principle, of the *Scarborough* Spaw-Water appear to be extreamly light and volatile; whence in order to its escape, (if ever it does escape the Body of the Water; and not still remain therein, under a different form) it shou'd seem to require the assistance of some more volatile Matter than itself, to carry it off; or such an one as is capable of rising freely in the open Air, or with a certain degree of Heat, not much less than the Heat of boiling Water: which are Properties that may comport with Air. But this is only a Suspicion; which will, possibly, be somewhat farther countenanced, or falsified, in the following Section.

S E C T. VII.

Of the Mineral Spirit of the Purging Water.

1. THAT the purging *Scarborough* Water, besides the aerial Principle, naturally contains what may be called a Mineral Spirit, we have already had considerable Intimations; amount-
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ing, perhaps, when duly compar'd and weigh'd, to a sufficient Proof of the Fact: But what this Spirit is, how produced, how lodged in the Water, how alterable therein, and what are its Properties, Virtues and Uses, remains the Subject of farther Enquiry.

2. And as, in the prosecution hereof, the common Experiment with Galls is of singular Service; or a principal Thing whereon the Evidence of the Fact, and the other Experiments, relating to this part of the Enquiry, depend; it may here be necessary to explain and illustrate this leading Experiment, and endeavour to derive it from its true Principles: For tho' the Experiment itself be common, yet the physical Reasons of it seem to be little understood.

3. And perhaps the Foundation of this Experiment cannot be more satisfactorily learnt, than by carefully attending to the Process for making the common black Writing-Ink, with Copperas, Galls, and Water; after some knowledge is gain'd of the Nature of the Ingredients employ'd therein.

4. Common Copperas appears to be no other than an actual Vitriol of Iron, made from the Pyrites, or Vitriol Stones, which abound with Sulphur and the matter of Iron; at least the Pyrites are separable, by Fire, into an actual Brimstone, and an actual Iron; as into two principal Parts, whereof those Stones consist. And accordingly, a true Copperas, or Vitriol of Iron, like that commonly made at the Copperas-works, may be easily obtain'd from a fermented or burnt Mixture of Iron Filings, Brimstone, and Water; as also from Iron alone, dissolved in a weak Spirit of Vitriol, or the Acid of Brimstone*.

See *Chemical Lectures*, Lect. XIX. Exp. 3 and 4.

And

And thus, if the common Copperas were farther examin'd, in its Origin, Properties and Effects, it will appear to be a true Vitriol of Iron, generated by a dissolution of that Metal, or the Matter of that Metal in a Mineral Acid, such as is naturally contain'd in Brimstone, or afforded by it, upon burning.

5. Galls, on the other hand, are a natural vegetable Production, of the astringent, or styptick, kind; somewhat like Oak-Bark, tho' more rough, styptick and astringent than that; whence the Powder of Galls is found to be what the Chemists call a light Absorbent, or Precipitant; which, when added to metallick Solutions made with the Mineral Acids, acts somewhat after the manner of Salt of Tartar, Quicklime, or other alkaline Substance, tho' less powerfully; so as to weaken, or blunt, the Menstruum, and cause a slow Precipitation of the metalline Matter, to the bottom of the containing Glass.

6. Copperas readily dissolves in Water, and for some time, remains totally suspended therein; but, by degrees, its more ponderous metallick Part spontaneously falls to the bottom, in the form of a yellow, or orange-colour'd Powder, or Oker; which, by fusion, may be reduced to Iron again; but, for some considerable time, as was before observ'd, this metallick Matter is also suspended, and uniformly diffused thro' the Body of the Water; so as to make a transparent, and if the proportion of the Copperas be small, a pellucid Solution.

7. Powder of Galls, tho' it does not totally dissolve in Water, yet readily communicates its finer tinging parts thereto; so as, if the propor-

tion of the Powder be large, to make a high colour'd Tincture, or Infusion; which if sufficiently diluted, or weaken'd with more Water, may also be made to appear pellucid. And in this manner, two pellucid Liquors may easily be procured, which upon being barely mixed together, shall instantaneously turn to a kind of black Writing Ink, like the ordinary sort, made in the common manner by a warm Infusion of Copperas and bruised Galls in Water.

8. To discover the physical Cause of the Effect here produced, or the Reason why Ink is thus obtained; it will be necessary to remember what was above deliver'd of the Nature and Properties of the two principal Ingredients concern'd; viz. that Copperas is Iron dissolved by an Acid; whereby the whole becomes soluble in Water; and (2) that Powder of Galls, or the Infusion of Galls in Water, is an absorbent, or a mild Precipitant, with respect to metallic Solutions: Whence it may be reasonably suspected that, in the making of Ink, the finer Parts of the Powder of Galls coming in contact with those of the Copperas, a beginning Precipitation immediately ensues; or, in other Words, that the Particles of the Acid in the Copperas, which kept the Particles of Iron dissolved in the form of a compound or metallick Salt, being now weaken'd, absorbed, or attracted, by the Particles of the Galls, rather more than by the Particles of the Iron; hence these latter are somewhat loosen'd from their former Texture, or Combination, in the Copperas, and now appear in their own natural, opaque form, or dusky colour; so as if numerous, to render the Mixture black; and disposed to let the heavier Matter,

ter, viz. the irony Particles, fall to the bottom.

9. But this shou'd be esteem'd no more than a Suspicion, till particular Experiments are produced to verify, or confirm it: thus especially it requires to be shewn that Iron alone may, without either Copperas, or Galls, be reduced to such a subtile Powder, as to keep suspended in Water, and constitute a black Ink, like the ordinary sort: for this ought to be the Case, if the Reasoning above be just; which supposes that Copperas is no farther of use in the making of Ink, than as it contains Iron subtilely dissolved, or reduced to fine Particles; whilst the Acid which reduced the Iron to this state has its farther Action upon it lessen'd or suspended.

10. And we have some Reason to believe, that the Experiment, when well made, might be attended with Success; or that a black Ink might be produced, barely by long grinding and digesting Iron and Water together; even tho' the Water shou'd be pure, or contain no acid or saline Particles; and tho' the Iron shou'd at first be clean, bright, or no way rusty. But as we have not brought this Experiment to full perfection, we do not here produce in direct Confirmation of the Theory above deliver'd; tho' we incline to think it might be carried so far as to shew, that the common Ink is little more than a Solution of Iron; and when dried in Writing, scarce any thing else but the Particles of Iron left upon the Paper.

11. That there is a tendency to Precipitation in Ink, may appear from hence, that if it be not thicken'd, or render'd somewhat glutinous, by the addition of Gum Arabic, Sugar-Candy, or the like, it is apt to deposite its irony Parti-

cles, in the form of a fine black ponderous Powder, at the bottom of the containing Glass; so as to leave the upper part of the Liquor clear or pellucid; and this tho' the Tincture of Galls is somewhat glutinous, or stiffening; whereby the irony Particles may be longer suspended, or kept from falling readily downwards.

12. But it may here be objected, that allowing the Particles of Iron may remain long suspended, and uniformly intermix'd with Water; yet it seems questionable whether these alone can communicate so great a degree of blackness as we find in Ink; especially as the natural colour of Iron in the Piece, is far removed from blackness; or even after being reduced to fine Powder by Calcination, or Rusting. The Answer to this Objection seems in part derivable from hence, that Iron is much more subtilly divided in Vitriol, by the interposition of the Acid, than it is by Filing, Rusting, or Calcination: and that even Silver and Gold, when reduced to Particles of a certain degree of fineness, are black; as we see in the strokes drawn with them upon the white plaistry Leaves of common Table-Books. Nor, perhaps, is Ink itself, when properly examin'd, of so deep a black, as that it may not be reasonably supposed owing to the fine irony Particles it contains; for if a small quantity of the blackest Ink be put into a very slender Tube of Glass, and viewed against the Light, it will appear not black, but almost as pale as common Water. But a more direct Answer to the Objection might be given; if Iron was once dissolved so intimately with Water alone as to constitute Ink*.

* See above, § 9.

13. Iron is of a very soluble nature, so as to dissolve in more Liquors than perhaps any other Metal; thus it is readily corroded and turned to Rust by standing in the open Air; and easily dissolves in many vegetable Juices; so as to form a kind of Ink; as appears upon the cutting of almost any Fruit with an Iron Knife. And thus rusty Iron readily makes Ink with the Infusion of Galls; and bright Iron also will do the same in a longer time, as we have tried: which nearly comes up to the Proof we want: where it may deserve to be remarked, that the Rust of Iron is a kind of imperfect Copperas, or Vitriol of Iron; as appearing to be made by some acid, or corrosive, Particles naturally floating in the Air, and falling upon the Iron; so as, in part, to dissolve, or turn it into Rust; which therefore is Iron open'd, and more disposed than bright Iron, to dissolve in Water, or to make Ink with a Tincture of Galls.

14. That Galls act as an Absorbent, or Precipitant, in the making of Ink with Copperas, may seem farther confirm'd by several Experiments; thus in particular; if the Powder of Galls be added to a mixture of Oil of Vitriol and Water, it appears remarkably to take off, blunt, or sheathe the Acidity of the Liquor; so as to render it less sharp upon the Tongue. Again, if a little Oil of Vitriol be added to common Writing Ink, not purposely made to prevent its being discharged, all the Blackness will be instantly destroy'd; and the whole Liquor appear pellucid, like fair Water; whence it shou'd seem, that the absorbing or precipitating Property of the Galls being now subdued by an over proportion of Acid; the irony Particles

are turn'd into Vitriol again; whereby the whole Liquor is reduced to the State of a weak or pellucid Solution of Vitriol, entirely wanting the Blackness of Ink. And on the same account it appears to be, that Ink-spots, or Iron-moulds, are taken out of Linnen by Juice of Lemmon, Juice of Sorrel, Verjuice, &c. as these acid Liquors dissolve the irony Particles, which, in that form, stick closely to the Linnen; and thus reduce them to the condition of a Vitriol of Iron; which will now readily dissolve, and be washed out by common Water.

15. And this seems farther countenanced from hence, that when Ink is turn'd to a pellucid Liquor, by the addition of Oil of Vitriol, or other Acid; the fresh addition of more powder of Galls, or any fix'd alkaline Salt, (so as sufficiently to lower the force of the Acid, or envelope its Particles) will instantly restore the Blackness to the Liquor, or turn it to Ink again; which, in this manner, may be several times discharg'd, and recover'd, in the space of a few Minutes.

16. Another Intimation that it is the Iron alone which constitutes Ink, may be derived from finding, upon trial, that no Acid, nor Oil of Vitriol, or Spirit of Sulphur, which with Iron constitute Copperas, will make Ink with Galls and Water: whence it seems a Consequence, that if Copperas be no more than a Composition of Iron and Acid*; it cannot be the Acid, but the Iron, in the Copperas, which makes the Ink; unless it can be shewn, or reasonably suspected, that the Acid acquires a new Proper-

* See above, § 4.

ty by the Mixture. But Oil of Vitriol is, by distillation, separated from Copperas, or the Vitriol of Iron, and found to possess the same Properties which it had before it was employ'd to dissolve Iron, for making the Vitriol. And the Remainder, or *Caput Mortuum*, as it is called, affords true Iron again by Fusion.

17. It remains to be farther observ'd, that no other Vitriol but that of Iron; not the Vitriol of Copper, or any other Metal which does not contain Iron, is found upon trial, to make a black Ink with the Tincture of Galls; whilst Iron dissolved in any mineral or vegetable Acid, is constantly found to make an inky Mixture with that Tincture; whence it shou'd seem to follow that Iron makes Ink.

18. But Galls are not the only Thing which makes Ink with Copperas, or Iron; since many other astringent vegetable Subjects are found capable of doing it; such, for Example, as Oak-Bark, Pomegranate Rind, Tea Leaves, &c. tho' always in a less degree, as they appear proportionably less absorbent, styptick and agglutinant. Since, therefore, no black Ink is found to be made without Iron, but may be made without Galls, it follows again that Iron is an essential Ingredient in Ink. And when all the Instances, both of the affirmative and negative side, (if any are producible on the latter) come to be well consider'd, we leave it to the Judgment of the Reader, whether Iron subtilly divided and suspended in Water be not what we call Ink.

19. And thus we hope to have shewn the Foundation whereon the common Experiment, of trying Mineral Waters with Galls, depends. We come now to apply it in examining the Mineral

neral Spirit of the Purging *Scarborough* Water: and in order thereto, wou'd draw this Inference from the Premises; viz, that as of all the Metals, Iron alone, and of all the Vitriols that of Iron alone, appears disposed to make a black Ink with Galls, or other astringent vegetable Substances; therefore, when any Liquor turns black with Galls, or such astringent Vegetables, this affords a considerable Intimation that a dissolved, or subtilized Iron, or the Vitriol of Iron is contain'd therein.

20. But to render this Experiment more useful and extensive, it shou'd be remember'd, that, as in the making of common Ink, the Liquor is, at first, pale and watery; but gradually grows more black by standing; as more of the Copperas and Galls comes to be dissolved therein; so, in the examination of Mineral Waters with Galls, there may be different Degrees, or Shades, of Blackness, produced; according to the quantity of irony Particles they contain; from a lightish red, or faint Pink-colour, to a deeper red, a purple, or a black. Thus when bright Iron is put into a slight Tincture of Galls, and suffer'd to stand in the Cold, the Liquor remains, for some time, unchanged in its Colour; but successively and slowly alters, from a light red to a full purple, that ends in a jetty black.

21. And thus when Powder, or Tincture, of Galls is added to the *Scarborough* Spaw-Water, a faint Pink-colour is first produced; which, at length, usually ends in a deep purple, or a considerable degree of blackness. But as the Water does not always turn of a deep purple, or black, with the same proportion of the same powder of Galls; we have hence an Intimation that

That it has not constantly the same quantity of Irony Particles; and this, tho' tried, with fresh Water, at the Spring-Head. And by means of this Experiment carefully made and varied, we may perhaps be enabled to determine the Seasons of the Year, and possibly the Times of the Day, or Night, when the Water most abounds with the Mineral Spirit, or Irony Particles.

22. But notwithstanding this Experiment may, when thoroughly understood and consider'd, afford a high degree of Evidence that Irony Particles naturally abound in the *Scarborough Spaw-Water*; yet the Art of Induction teaches us not to rest in any single Experiment that is not fully demonstrative; and accordingly directs us to look out for farther Proof, or Confirmation. And such farther Proof or Confirmation seems, in some degree, procurable by barely prosecuting the same Experiment, in the following manner.

23. To several Quarts of the Water fresh taken up, we added an ounce, or more, of the Powder of Galls; stirring them well together; upon which a considerable degree of inky Blackness soon ensued. We let the Vessel rest for several hours, and found that the grosser Part of Powder of Galls, together with the Blackness, gradually fell to the bottom; where being fully settled, we poured off the Water that floated above it, and dried the Powder; which now appear'd considerably black. Whence it shou'd seem that the Irony Particles of the Water gradually subsided, and remain'd intermix'd among the gross Powder of Galls; the Water which was poured off appearing very little discolour'd, or almost pellucid; as sometimes happens in the making

making of Ink, when the blackness falls to the bottom, and leaves the upper part of the Liquor clear *.

24. And hence it shou'd seem, that the irony Particles of the Water are not extreemly volatile; as they do not thus appear to fly off at the surface of the Water, tho' exposed to the open Air for several days; the black Matter still remaining, unalter'd as to colour, at the bottom. At least we have here a clear Intimation that an irony Substance is precipitated from the Water by the Powder of Galls; in the same manner as if a small proportion of Iron, or the Vitriol of Iron, had been dissolved therein.

25. But if this be really the Case, we may reasonably expect to find some signs of Iron, upon examining the dry Powder, gain'd from the Water by Precipitation with Galls; and accordingly, having calcined, or scorched, a part of this dry Powder, in an earthen Crucible, over the Fire; we afterwards applied an armed Load-stone to the scorched Powder; and found that some considerable Particles of Iron rose from it, and clung to the Iron-Capping; as others did also to a Knife-Blade, that had been touched with the same Load-stone.

26. But, as it may be suspected that the Iron here attracted by the Load-stone, was owing to the Galls employ'd; because all vegetable Subjects are found, after due Calcination, to afford some Particles of Iron; we, at the same time, scorched some Powder of Galls, in the same light manner; but upon applying the Load-stone thereto, did not observe that any Particles of Iron were attracted: And this, possibly,

* See above, § 11.

because

because there was not a thorough Calcination made; the Intention being only to scorch both Powders alike. So that, if these Experiments hold, or shall appear upon farther trial to answer in this manner; a strong Intimation may be hence derived, that irony Particles are naturally contain'd in the *Scarborough Spaw-Water*, after such a manner as to be fix'd by means of Galls, and a light Calcination; and reduced to the solid form of Iron. Tho' this Point also may be farther confirm'd, upon finding, as from some Trials it appears to be found, that a solid Lump of Iron is obtainable by fusing, with a strong Blast-Heat, a proper quantity of the Powder or Matter, gain'd, by Precipitation, from the Water.

27. Now, if these Facts shall, upon full examination, prove to be certain, or receive the Confirmation required by the Art of Induction; we may hence be led a Step farther in our present Enquiry, and proceed to examine (1) whether these irony Particles in the Water are not what may, in a due sense, be called its Mineral Spirit; (2) how this Spirit originally comes into the Water; (3) under what state it exists therein; as whether it be directly irony or vitriolick, volatile, or fix'd; (4) what Change it is liable to; (5) what are its Virtues, and what its Uses to the Water, &c.

28. It may seem to be satisfactorily proved, that irony Particles are naturally contain'd in this Water; so as to make a constituent part thereof; and as in its sound state, there appears to be no other direct mineral or metallick Matter contain'd therein, distinct from the saline and earthy Principles; we are obliged to make this the Mineral Spirit of the Water, if it be allow'd

allow'd to have any that may properly deserve the Name.

'Tis true, this Name seems to imply, not only a great degree of subtilty in the irony Particles, but also a degree of Volatility; so as like the aerial Principle, easily to fly off, and quit the Body of the Water, whenever it has the opportunity. But whether it really does this, has not been made appear: so that, if the Iron contain'd in the Water be not volatile, but only finely divided, like the Iron contain'd in Ink, or other common Solutions of Iron; the Term Spirit may seem somewhat improperly applied thereto. Just philosophical Names can never be given to Things, till their Natures are known; whence farther Enquiry must determine whether the irony Particles in the *Scarborough* Water be a Spirit or not.

29. And, possibly, a careful examination of the Beds over which the Water runs, may intimate that this supposed Spirit is no other than a certain proportion of the finer matter of Iron or Oker, lightly dissolved in the Water. The great solubility of Iron itself, even in the solid metallick Mass, has been mention'd above; in-somuch that Ink may be made by barely suffering a lump of bright Iron to remain, for some hours, in pure Water impregnated with Galls. And Naturalists find signs of Iron near the Confines of Chalybeate Mineral Waters; as in particular there are many such signs to be found near the Course of the *Scarborough* Spaw-Water: whence it seems rational to suppose that the Water becomes impregnated with its irony Matter by passing over certain Beds, or Veins, of soft Oker, or soluble Iron-stone. And if common Water, by being made to pass thro' the same Channels,

Channels, shou'd be found to be thus impregnated; this might amount to a kind of Confirmation of the Suspicion.

30. But, to determine, with Certainty, under what form these irony Particles naturally exist in the Water, several Experiments will be required. And the View shou'd here be directed to discover whether they exist under the form of Vitriol, or a mere Iron, subtilly divided; and again whether under a considerably volatile, or a more fix'd State. If they existed in the Water under the form of a fix'd Vitriol, like the common Copperas, or Vitriol of Iron; it might be reasonably expected that the Vitriol shou'd thus manifest itself to the Taste; as Vitriol of Iron remarkably does, tho' but a very small proportion thereof be dissolved in Water: at least it shou'd manifest itself after the Water has been, for some time, boiled; so as to exhale a large proportion of the aqueous Part, and bring the particles of the Vitriol much nearer together; in the way of a strong Solution of Vitriol, capable of shooting in the Cold; as fix'd Vitriol is known to do. But no such Thing is found upon evaporating the Water; and therefore we may well suspect or conclude that it contains no fix'd Vitriol of Iron; especially as some hundred Gallons of the Water have been boiled to a small quantity, without finding any thing like this Effect.

31. So, likewise, if the irony Particles existed in the Water under the form of a volatile Vitriol; it might be expected at least when the Water is strong, or richly impregnated therewith; that this also shou'd be manifest to the Taste; whereas, when the Water is strongest, it does not seem to taste properly vitriolick, but rather

rather brackish, irony, or okry, with regard to the Taste of the Mineral. Nor do we remember to have met with such a Thing as a volatile Vitriol of Iron, capable of totally subliming with Heat; unless the *Flores Salis Ammoniaci martiales*, or Iron sublimed with *Sal-Ammoniac*, may be so called.

32. Again, if these irony Particles are naturally volatile, whether vitriolick or not; it shou'd seem that some certain Expedient might be used to collect, or detain them; so as to render them more manifest or sensible. That they are not extreamly volatile, we have already had considerable Intimations; as they do not readily fly off in the open Air, nor over the Fire, without a scalding Heat. And that they do not quit the Water, and pass thro' the Pores of Glass, in many Months time, we are tolerably assured; by having known the Water kept in well-closed Glasses, for eight or nine Months, in a perfect State; so as to strike purple, or black, with Galls; apparently as strong as when fresh taken up at the Well. Nor does it seem probable, that these irony Particles shou'd escape thro' the Pores of a well oiled Bladder, where Air itself, a much more volatile Substance, is confined. And hence it might be proper to try, if this Mineral Spirit cannot be, some way or other, collected, in a separate State, from the Water, and the rest of its Principles.

33. With this View, the Experiment above described*, may be repeated, and diversified, with the requisite Care and Skill, to try, whether, after the aerial Principle has, by the Air-Pump, or otherwise, been in good measure discharged from the Water; and the Mineral

* Sect. VI. 3—6.

Spirit left behind; this cou'd not be made to rise, with a boiling Heat, and come over into the Bladder, as into a Retort; and there be collected; as the aerial Principle has been. So again, it might be tried, whether this Spirit cou'd not be brought over by distilling the Water in a common Glass Retort, into a Receiver containing the Tincture of Galls; which shou'd rise so high therein as to cover the Nose of the Retort; observing whether the Tincture wou'd thus, at the beginning of the Operation, turn black or purple. And many other Experiments of this kind might be contrived; but if none of them answer'd, it wou'd hence appear reasonable to conclude, that no volatile Iron, or volatile Vitriol, cou'd be obtain'd from the Water; and consequently an Intimation be gain'd, that none was contain'd, under a volatile form, therein.

34. These Experiments, when made, may be compared with those of a different kind, which shou'd tend to discover what Changes the Water undergoes, whilst it remains in Glasses sealed Hermetically, as it is called; viz. by melting or softening the neck of the containing Glass with Heat, then twisting it so as to confine the Water totally in Glass, without the assistance of Cork or Cement. Or, what seems as useful, and more instructive, in the present Case; the Water may be carefully bottled at the Well-head, then oiled at the top, after the manner of *Florence Wine*; and lastly, well cork'd and cemented. For thus the Water has been found to continue many Months possess'd of its irony Particles; even after being carried, (with Care to keep the Bottles upright) a great number of Miles. And by diligently observ-

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ing what happens to the Water in this State, some considerable Light may, perhaps, be gain'd in the present Enquiry.

35. And since it plainly appears that the Water by standing, or by being carried, in this state, does not, for a very considerable time, lose its property of striking black, or purple, with Galls; hence it seems certain, that the irony Particles, or Mineral Spirit, of the Water, cannot easily escape thro' the Pores of Glass; at least, not whilst the Water remains in a sound state: which is added, because when the Water begins to corrupt, as in time it will, even tho' thus secured; it tinges less and less with Galls; and at length, affords no red, purple or dusky Colour therewith. Whence we are led to suppose, either that the irony Particles, at this time, make their escape thro' the Pores of the Glass, or of the Oil, the Cork and Cement; or else are so changed, as no longer to retain their irony Nature, and strike with Galls.

36. That the latter is rather the Case, seems countenanced by this, that during the Alteration, or Diminution of the tinging Faculty; there appears to be a manifest Change in the natural Texture of the Water; for a visible separation of Parts ensues; the whole grows fetid; a gross Matter falls to the Bottom; the Oil, that was liquid before, now becomes almost as hard as Tallow; and appears tinged black to a considerable height: but what is most remarkable, the Water now affords manifest Signs of its containing actual Brimstone; not the least Indications whereof appear'd before. And here is a Scene open'd which we are not, at present, to enter upon.

37. This

37. This Intimation, however, may seem afforded by the Premises, that the Water, as taken from the Well, is a compound Liquor, gradually tending to alteration in its Parts, as if there was a slow, and silent Fermentation among them; whereby the natural Texture, or Arrangement, of the whole is broke in time; even tho' the external Air be kept from communicating therewith; but if the external Air be admitted, remarkable Changes much sooner begin, and finish their Period. And hence, perhaps, it may be reasonably suspected, that the Mineral Spirit here suffers a change in its nature; or that the irony Particles may even be demetalized, and lost in their pristine form, or converted, at least in part, to Oker, Earth, or Sulphur; to which they, possibly, have a near Relation. But this is hinted only as Matter of farther Enquiry: for we are determin'd not to pronounce without clear and full Evidence; which we apprehend may always be had in physical Enquiries.

38. Supposing, therefore, the existence of fine irony Particles, in the natural and perfect *Scarborough* Spaw-Water; we now proceed to consider their Uses and Virtues; which seem, in good measure, derivable from the Art of Medicine, and the known Effects of chalybeate Preparations. And tho' these irony Particles seem to be few in the *Scarborough* Spaw-Water, with respect to the common Tinctures or Solutions of Iron, found in the Shops; yet they may have considerable Virtues; as appearing to be a natural Preparation of Iron, more subtle, exquisite, and homogeneous, than those of the artificial kind; as being mild, and made without any highly corrosive Menstruum. Whence

it might be proper to examine whether the softer Oker or *Minera Ferri*, which may be found in the Course of some Mineral Springs, is not capable of affording better chalybeate Medicines, than such as are usually order'd in Dispensatories. Perhaps a noble Tincture of Iron, or *Essentia Martis*, may thus be obtain'd.

39. The Experiment also may be worth the making, in order to discover whether common Water cou'd not be impregnated with irony Particles, after the manner of all Spaw-Waters, by a bare Infusion of the *Mater* or *Minera Ferri* therein; at the same time observing what Alterations such an Infusion is subject to, by standing exposed to the open Air; and again upon being hermetically sealed up in Glasses. For, if a separation of Parts shou'd quickly ensue in the former Case, and slowly in the latter; and the irony Particles at length appear to be turn'd into Oker, Earth, or Sulphur; this might afford a kind of Confirmation of the Suspicion above deliver'd, as to the change of the natural Spaw-Water, and the loss of its irony Particles, in their irony form, by standing.

40. The medicinal Virtues of a subtilized Iron are generally allow'd to be deobstruent, strengthening, or invigorating; at the same time that it is the most innocent, and wholesome of all metallic Substances; whence, perhaps, this subtilized Iron is no inconsiderable Ingredient in the *Scarborough* Spaw-Waters, as it may help to promote their other Virtues, or render them lightly chalybeate, without impairing the Virtues of the other Principles, or any way interfering, but rather conspiring with them. And if this chalybeate Virtue shou'd be required in a higher degree, we may be instructed by the present

present Enquiry, how to increase it in the Waters, by the artificial Introduction of a subtilized Iron into them. Or, if in any Case this Virtue shou'd be thought improper, as sometimes it may; 'tis easy to lessen it, by boiling the Water, or suffering it to stand open, or barely exposed to the Air, for some time.

41. We cou'd here subjoin several considerable Experiments, and Observations, with regard to this Mineral Spirit of the Water; and perhaps bring the whole Affair to a tolerable degree of Certainty: but to do this in so full and exact a manner as we cou'd wish, wou'd lead us too far from the present purpose, and engage us in the Analysis of the Water under a state of Corruption, or Putrefaction. We, therefore, choose to stop here for the present; with this Intimation, as a general Fruit of the preceding Enquiry, that, possibly, an exact and full Analysis of any Mineral Water, may lead to a clear, distinct and serviceable Knowledge of its different component Parts, or Ingredients; as also their respective Virtues and Uses. And thus, when the Analysis of the purging *Scarborough* Water is carried to its full length, and duly verified in all its Parts; this Water will, perhaps, appear to be a natural Compound, consisting of much fine Water; a variable Proportion of a certain neutral, purgative Salt; a little Sea-Salt; an alkaline Earth; Air, and a subtilized Iron; all mix'd together, under one certain Form or Arrangement; so long as the Water continues in its natural sound State. And hence it shou'd seem that the Medicinal Virtues and Uses of this Water, are derivable from such a full and exact Analysis; as depending upon the Virtues and Uses of the several Ingredients,
thus

thus combined together; provided we had a previous Knowledge of the true Causes of Diseases, and the nature, frame and make of the Body; so far, we mean, as this might be gain'd by the Art of Induction. But as this Art has hitherto been little, if at all, applied, to discover the real, internal Natures of the Solids, and Fluids, of the Body, the Changes whereto they are subject, and the true Seats and Causes of Distempers; no rational Attempt can hitherto well be made to determine the Medicinal Virtues and Uses of a Mineral Water *à Priori*, as it is called; tho' we had ever so exact and full a knowledge of the Contents of such a Water. And in this State the Matter appears to rest on the side of Medicine; whose highest Improvement may, perhaps, be rationally expected from the Art of Induction; as we hope hereafter to make more fully appear.

42. And thus we have gone thro' the imperfect Analysis at first propos'd; and briefly consider'd the several Principles into which the Water has been resolv'd by its means; tho' without denying that there may, possibly, be others; or that these may be farther resolv'd, or render'd more simple. If this Work shall happen to be continued, 'tis hop'd it may end in the Discovery of a sure Method of tracing out the Virtues and Uses of all Mineral Waters; and of procuring their Contents unalter'd in their natural Properties; so as to enable us to recompose the respective Waters from them; heighten their Virtues in some Cases; lower them in others; make artificial Imitations thereof; and thence improve the Arts of Pharmacy and Medicine.



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THE following TESTIMONIALS have been transmitted to the said *John Fiddes*; one from the Magistrates of *Spa* in Germany, which has the Arms of His Highness the Bishop and Prince of *Liege*, and the Seal of the Magistrate of *Spa*, as in the Margin; the other from *Culmer Cockerill Esq.* Senior Bailiff of *Scarborough*, and *Dr. Shaw*, Physician of that Place.



Nous les Bourguemaitres & Magistrat de SPA au Marquisat de Franchimont, Pays de Liege, Certifions que les 150 Bouteilles en un pannier que le *Sieur Alexandre Hay*, Marchand a *Spa*, a fait Emplir pour envoyer a Monsieur *Jean Fiddes*, Marchand a *Londres*, ont été de bon tenu & s'ont remplies a la bonne & véritable source des Eaux Minerales qui coulent en ce lieu accomodées par le ditte *Hay* & ces Domestiques, & cachetées au cachet ordinaire. En foi de quoi avons la presente fait sous-signer & cacheter par notre Greffier,
par Ordonnance G. STORHEAUX.

N. B. I have the like Certificate with every Parcel of Water.

N

THE



THE Pouhon Water of Spa, filled for Mr. John Fiddes, in Tavistock-Street, Covent-Garden, London; the Wind being North and freezing, and sealed with a Hand and bloody Yoke; the Motto, **FIDUCIA VICTRIX**, and **POUHON SPA**, by me,
ALEXANDER HAY.

N. B. Mr. Hay's House is adjoining to the Pouhon Spring; he having the best Opportunity of taking up the Water at the most proper Seasons.



WE whose Names are here subscribed do certify, That the Scarborough Spa Water, filled for Mr. John Fiddes, and sealed with the Corporation-Seal, is constantly taken up from the **WELL** at the most proper Seasons, and cemented down in the Bottles with a well-adapted Cement, according to our Directions:

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PETER SHAW.



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